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Turning in a Crop Residue on a New Zealand Smallholding

VOLUME 5, No. 6 JUNE 1953

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WORLD CROPS

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Editorial Comment

WORLD CROPS offers respectful salutations and good wishes to Her Majesty the Queen on the occasion of Her Coronation on June 2.

The International Wheat Agreement

IN our issue for February we alluded to the difficulties likely to arise over the renewal of the International Wheat Pact; since then these have become acute. The present International Wheat Agreement, which 46 nations signed in 1949, expires on July 31 next. Its effect was to stabilise wheat export and import quotas to its member nations with a maximum wheat price of $1.80 (12s. 10d.) per bushel and a guaranteed minimum price of $1.20 per bushel.

At its recent meetings, the Wheat Council decided on April 9, by a majority, to recommend to its constituent member Governments that the agreement be extended for a further three years at a new price range of $2.05 maximum and $1.55 minimum. Great Britain informed the other members, however, that while she desired to see an extension of the agreement, she was not prepared to accept renewal at a maximum price above $2.00 per bushel.

As the London *Times* remarked in a recent leading article, this decision seems unquestionably right, not because wheat purchased under the new agreement would cost more than wheat purchased from British farmers, nor even because another 5 cents on the bill would involve the payment next year of another £33 million, but because $2.00 is high enough or indeed too high by normal commercial standards, and another 5 cents would be a concession not to economic realities but to the exaggerated ideas of the United States farm support policy and programme.

The underlying difficulties

ACTUALLY, wheat is more than plentiful. Following an all-time record harvest in Canada, and one in the U.S.A. which was well above the average, the United States Commodity Credit Corporation is reported to be holding vast quantities of wheat off the market. In the opinion of competent judges, the price today could not possibly be more than $2.00 were it not for Government intervention. Indeed, many consider that in any event the price cannot be sustained at that level.

The decision of the United Kingdom has called forth strong protests in the U.S.A., and Mr. True Morse, U.S. Under-Secretary for Agriculture, is reported to have stated that it would be deplorable if Britain did not change her mind. It is curious to recall that many years ago when the first International Rubber Agreement was in the balance, the U.S.A. were foremost in denouncing the United Kingdom for her alleged use of the agreement to force the price of rubber up in favour of the grower. It appears that in the present case the U.S.A. is pledged to support the domestic price of wheat at a statutory parity with a range of other goods; stocks of wheat bought under this obligation have been purchased at prices from $1.90 upwards and the present mandatory price is about $2.20, which led the U.S.A. to ask originally for a maximum price under the new agreement of $2.50 which, in the absence of support from Canada, she reduced subsequently to $2.25.

The price the U.S. Government chooses to pay her producers is, of course, her own affair, but it hardly seems unreasonable of wheat-importing countries to expect that she should pay her own subsidies. Her power to withhold wheat is, of course, very considerable but it is hard to see what reason there is why Great Britain, especially in the light of past history, should be intimidated into paying an excessive price. Actually, Britain is the largest wheat importer in the world and it seems at least unlikely that an agreement will be capable of being worked without her.

Meanwhile, at the time of writing, it is reported that the agreement has been signed by 27 countries, including four exporting and 23 importing countries. The exporting countries are Australia, Canada, France and the United States, although already one of the signatories, Australia, has intimated that her signature does not bind her to become a party to the agreement, which is subject to acceptance by Governments in accordance with constitutional procedures. This action was inspired, it appears, from a statement by Mr. J. McEwen, the Australian Minister of Commerce, by the desire to ensure that Australia would be able to continue to supply traditional customers for Australian wheat, should they not become parties to the agreement themselves, thereby presumably meaning the United Kingdom. It remains to be seen whether other signatories will enter similar caveats at a later date, thereby paving the way to a settlement more in accordance with British ideas.

East African anxieties

EVENTS in Kenya have culminated in the recent outbreaks of violence on the part of the adherents of Mau Mau and have conduced to widespread anxiety as to the future, which despite active steps to apply remedial measures so far do not show reasons for becoming allayed. To outside eyes at any rate and even to some of the inhabitants of East Africa itself the underlying causes of the outbreak are difficult to fathom. Dissatisfaction with existing conditions, political aspirations and the teaching and indoctrination of partially educated Africans by European doctrinaire exponents of extravagant theories who ought to know better, are no doubt partially contributory causes, but it is difficult to credit that they can entirely account for the astounding savagery and brutality displayed in the manifesto to its members which, according to the press, the Kenya Government has recently captured from Mau Mau groups, containing as it does the most gruesome and horrifying threats

of physical violence to all Europeans who are so luckless as to fall into Mau Mau hands.

No thinking person can deny that during the past 70 years the very great advances in production and prosperity of all sections of the East African community, including the Africans themselves, the gift of peace, the control of human, animal, and plant disease, better housing, transport facilities, are due to one thing and one thing only, *viz.*, the penetration of European races into the African continent. Memories are short, but within the lifetime of many—the present writer included—Central Africa was still largely unknown and unexplored. Such tales as did filter through to Western ears were decidedly alarming. It was in the latter years of the 19th century that the explorations of missionaries and explorers, such as Livingstone and Stanley, revealed the terrible truth to the world and the existence of unimaginable horrors, which presumably had been in existence for thousands of years, largely it must be admitted, because the inhabitants did not possess the ability to initiate a better condition of affairs of their own volition.

The roots of development

IT was these revelations which aroused the feeling among thinking civilised peoples the world over that such a state of affairs could no longer be tolerated and led to the inauguration of the period of European penetration.

It seems undeniable that the feeling and emotions displayed in the manifesto referred to above are precisely those which lay at the root of the unbridled savagery and brutality characteristic of African conditions before European development began. In the circumstances, it is difficult to imagine anything more unfavourable to the cause of African political development since many must accept it at its face value as direct evidence of the inability of Africans in their present stage of development to rid themselves of these primitive and anti-social instincts.

Let us hope that before long the reaction will set in and these sinister emotions will once more retreat into the obscurity which they merit, for while they are in evidence there is little hope for the successful application of modern scientific methods of agricultural production which alone can solve the grave population problems with which the world is faced.

The olive fly

THE decision of FAO to convene a conference in Florence in March last to discuss the control of the olive fly, *Dacus oleae*, was timely and appropriate. This little insect has been known for many years as a pest of the olive trees which are such an important item of cultivation around the Mediterranean region. The fly does each year an enormous amount of damage to the olive crop in this area, reducing the crop by causing the fruit to drop prematurely and impairing the quality of infested fruit which recovers from the attack.

Since 1945, an increasing amount of research has been in progress on the pest in various Mediterranean countries with the object of finding effective methods of combating the fly and reducing the damage done by it. It has been roughly estimated that the damage done by the insect is very considerable and may amount to as much as £20 to £30 million per annum. It is also known that there are centres where infection by the fly is endemic, usually they are low-lying, humid areas with a narrow range of temperature variation.

In good years, infection is largely confined to these endemic regions, but in bad years the areas of attack may spread far beyond them up to as far as 200 miles according to the season. The breeding cycles of the fly vary also with the season, for in some years there may be five or six generations in the year, in others only two; when meteorological conditions are favourable breeding may not cease even in the winter; the peak period of *Dacus* infestation varies from July and August in parts of Greece to October and November in Spain, Algeria, Tunis and Italy.

Results concerning methods of controlling pest are conflicting. BHC and DDT sprays are reported to be showing toxicity to *Dacus* at economic rates of application. Biological methods of control by means of parasitic insects have also apparently been considered to offer promise. A difficulty is that control methods which prove satisfactory in Northern Italy, for example, may be difficult to employ in Tunisia or Algeria where conditions are widely different.

The object of FAO in calling the conference was to examine the fundamental problems presented by the control of the insect, and to encourage interested Governments to integrate and co-ordinate their researches. No reports of the conference have yet come to hand, but we are informed that 19 nations were invited to attend the meeting which promised to be of considerable value and interest.

Agriculture in Eire

IN the *Times Agricultural Review* for the spring of 1953, there appears an article by Mr. John S. Barrington under the challenging title of 'Is Eire Pulling Her Weight?' After considering various aspects of the agricultural situation in Eire, the author comes to the very definite conclusion that Eire is not pulling her weight in the agricultural field. Mr. Barrington points out that the 1948 trade agreement between Eire and Great Britain has yielded disappointing results. Thus exports to England in 1952 included 298,000 cattle, 26,000 cwt. of bacon and ham, 1,841,000 great hundreds of eggs, and practically negligible amounts of butter. By contrast, in 1929 exports to England included 774,773 head of cattle, 500,000 cwt. of bacon and ham, 4,810,940 great hundreds of eggs, and 560,482 cwt. of butter. Butter exports from Eire have declined because of the diversion of milk supplies to manufacturing purposes. Actually, at present, New Zealand butter is being shipped to Dublin.

Irish exports of agricultural produce are at present very small compared with those of Denmark for example, notwithstanding that natural conditions are on the whole distinctly more favourable. Compared with the position 100 years ago, there has been a very marked falling off in the area cultivated; thus in 1851 the cultivated area amounted to 3,509,229 acres, while today less than 1,750,000 acres are under the plough. This is in part the result of emigration.

but it is also in part due to, in the opinion of the writer, a series of unsatisfactory agrarian policies. The main agricultural achievement of the past few years has been the establishment of the beet sugar industry now carried on at four factories which in 1951-52 produced a total of 89,000 tons of refined sugar.

The writer considers that the present position is largely the outcome of the lack of general education which hinders popular appreciation of the facts of the position coupled with an agricultural policy which in his opinion does not meet the needs. It seems truly very disappointing that after 30 years of independence the agricultural situation in Eire should have suffered this continued deterioration. After all, the need for increased and improved agricultural production is just as urgent in Eire as elsewhere in the world, while the climatic and soil conditions over a considerable portion of the country favour production. Latterly, the Eire Government has sought the aid of the Food and Agriculture Organisation in its efforts to improve agricultural production. Let us hope that this may result in the amelioration of a deteriorating situation.

Colonial insect pests

ON another page we print a report of the recent Colston Symposium on colonial insect pests and their control. The conference must be counted to have been a considerable success, mainly because of the publicity it gave to the importance of insect pest control as a factor influencing crop returns in colonial agriculture at a time when world food demands are intensifying greatly.

Early in the conference, it was pointed out that programmes of attack revolved round knowledge of the pests and their surroundings. Fundamental to this is the knowledge that the pest does indeed reduce the yield of a crop and the cash return from it. Accordingly, the economist lays down the need for research into control methods, the entomologist decides whether chemical control provides the answer to the economist's prayer, the chemist and the manufacturer endeavour to find a chemical or chemicals which give promise of doing the job effectively, while at the end of the chain comes the engineer, who is called in last of all to devise machines which will apply the chemical to the crop in the most effective way.

This does not alter the fact that the engineer must also study the life history and behaviour of the pest itself, must also know a good deal about the crop attacked, its life history and its cultivation, must understand the nature and properties of the chemical or chemicals proposed to be used, and must be fully instructed concerning various local circumstances and conditions, including weather likely to be encountered, the nature of the terrain, the habits and character of the crop plant, *e.g.* its leaf surface, its exudations, etc., all of which contribute towards helping him to design and test his machine.

In the colonies at present, spraying and dusting machinery find limited use; nevertheless, we must look to the future. At the conference, two opposing views found expression. On the one hand, plantation methods of growing tropical crops are applied on so wide a scale and the economic losses from failure to control pests are so very considerable that under such conditions the most effective and economical machines that can be devised for applying pesticides are in considerable demand. This may lead to increasingly complex methods of operation. Against this must be set the fact that at present by far the larger part of production in the tropics, particularly food production, is based on peasant farming methods on small plots.

Here the entomological problems may be the least of a host of limiting factors to production, and though pest control may raise yields the increase may be minimal because of the poor husbandry practised by the cultivator.

As we have often argued in these columns, the ultimate solution is bound to be the gradual evolution of methods of operation whereby smallholdings may be grouped and made to operate with something of the efficiency of the plantation, but until this consummation is achieved the approach and production of control machinery for use under colonial conditions seems to be twofold, (*a*) the very simple application for use on the smallholding, which must be cheap yet need not necessarily be inefficient, and (*b*) the very good and efficient method of application which may be, but not necessarily is, elaborate and costly. An example of (*a*) is the cigarette tin with holes punched in it, and of (*b*) the many forms of high and low volume sprayers, both aerial and terrestrial, which make their appearance with ever increasing frequency today.

Sugar cane varieties in Mauritius

ALTHOUGH the island of Mauritius is one of the more remote places of the tropics, it has nevertheless some noteworthy characteristics. Located some 500 miles to the east of Madagascar, in the Indian Ocean, it has an area of 720 sq. miles, a population approaching the 500,000 mark, and produces nearly 500,000 tons of sugar each year. Formerly, the production of sugar was about half this quantity from roughly the same area, but in the last 25 years it has more than doubled itself, a result to be attributed partly to improved methods of manufacture, but in the largest measure to the introduction into cultivation of new and more productive varieties of sugar cane bred by the Sugar Cane Research Station inaugurated as a branch of the Department of Agriculture of the colony some 24 years ago and paid for by means of a cess on sugar exports. As one authority recently remarked, surely few colonial research projects can have paid better dividends.

This station has been responsible for the production of a number of valuable cane seedlings, but its principal achievement must be reckoned to be the production of the cane variety which is now almost universally cultivated in the island known as M.134/132. This variety originated in 1932 as a hybrid between two well-known earlier varieties, *viz.*, POJ.2878, which originated in Java at the well-known Pasiruan Experiment Station, and D.109, which originated in Demarara. Both varieties had been introduced into Mauritius at an earlier date and the cross was made as part of the programme of raising new canes by hybridisation,

using modern genetical techniques carried out by the plant breeding experts of the station. This cane, in addition to giving high yields as a plant cane, has, under Mauritius conditions, also excellent ratooning powers, has a high sugar content and is very resistant to drought and to various diseases. In particular, it has shown a high degree of resistance to the attacks of the melolonthid grub *Clemora* (*Phytalus*) *Smithi*, an insect which attacks the roots of sugar cane and which took a heavy toll of sugar canes in Mauritius formerly.

Certainly, it appears that in this variety Mauritius has obtained a cane of high value, but it must not be forgotten that the history of cane varieties has shown in the past that after prolonged cultivation cane varieties tend to ' run out ' or deteriorate and only time can show whether the same fate may not befall this excellent cane. On this account, the work of breeding new varieties must on no account be discontinued in order to safeguard the future.

A potato conference

FOLLOWING the example set last year when they organised a conference on cereals in Edinburgh, the Food and Agriculture Groups of the Society of Chemical Industry recently organised a conference on the potato.

Held at the Sele Hayne agricultural college at Newton Abbott in Devonshire, the conference attained distinction particularly by reason of the remarkable and erudite discourse of Dr. Redcliff Salaman, the doyen of recognised authorities on the potato, in which he treated of the early history of the tuber in the regions of the Andes, so far as it has been laid bare by recent researches, and the influence it exerted on the cultures of the pre-Inca peoples of the Andean regions, which manifested itself in ancient pottery in which the potato was portrayed in anthropomorphic form in jugs and similar vessels, illustrations of which Dr. Salaman exhibited to his audience. Introduced into the eastern hemisphere about 350 years ago, the hold which the potato has obtained on certain countries is, indeed, remarkable and as Dr. Salaman pointed out there may be grounds for suggesting that in countries where a potato economy has replaced a cereal economy it has often been associated with a low standard of living and inability to raise this standard to better levels. Eire may be a case in point.

One wonders, if this is admitted, whether it holds good also for communities which live on the starchy roots such as yams, cassava, sweet potatoes or colocasiae, as contrasted with those which subsist on cereals such as rice or the millets.

Another feature of the conference was the lecture given by Dr. Black of the Corstorphine Plant Breeding Institute on the efforts of recent years to breed varieties resistant to some of the diseases which attack the potato, notably the range of virus diseases and the many strains of the rot disease caused by *Phytophthora infestans*.

In the latter regard, Dr. Black explained the difficulties which the plant breeder has to face in his efforts to raise *Phytophthora*-resistant varieties by reason of the ability of the fungus to produce new strains which can overcome the resistance of newly evolved resistant varieties. The capabilities of other fungi in a similar direction are well known, *e.g.* the many strains of rust in wheat, the versatility of the fungi here suggesting the ability of a skilled Rugby forward to break through the defending pack of the opposing team.

It seemed rather a pity that an opportunity was not also given to the crop protection specialists to expound the success which had attended their efforts to solve the same problem by means of fungicide and insecticide treatments. Apart from this, the meeting must be admitted to have been a great success.

Desalting brackish water

ONE of the problems of world-wide importance is that of removing the excess of salt which contaminates surface waters in many parts of the world. If processes could be devised which could accomplish this economically, efficiently and speedily, it might greatly help in providing water supplies for humans and livestock in arid regions and might possibly enable supplies of water to be used for irrigation and crop production which, at present, cannot be used on account of their excessive salinity; in addition, it might also provide a powerful aid in dealing with the problem of accumulated salinity on lands which are irrigated with fresh water and which become saline in time owing to the accumulation of salt in the surface layers through evaporation or the raising of salt to the surface by capillarity from deeper layers. A number of processes are available for further examination as possible practicable methods of desalting water; these include ion exchange, separation by freezing, electrolysis and vapour compression distillation; it must be admitted, however, that none of these at first sight offer much promise as means of providing water that can be used for irrigation, whatever uses they may have for providing potable water in arid situations.

Nevertheless, it is good news that last year a working party was set up under the auspices of OEEC for the purpose of studying the desalting of water, and that this body has appointed a panel of experts to study the four processes mentioned above. It is reported that this panel is now preparing its report to the working party. On the information so furnished, the working party hopes to be able to recommend one or more of the processes for co-operative trial and development in countries party to the OEEC agreement, including the United Kingdom and the Netherlands. It is true that salination is not yet a serious problem in the United Kingdom, although there are signs that it may become so in the not too far distant future in some localities. In the Netherlands, on the other hand, it is already a serious matter since in many localities the underground water level is falling and salinity is increasing. Indeed, the appointment of this working party was first suggested in the Netherlands. We might remind our readers that a description of the position in the Netherlands in regard to the increasing salinity of ground-waters appeared in WORLD CROPS, Vol. 4, p. 400.

Co-operation and Integration in Oil Palm Research

S. de BLANK, B.Sc.
Huilever S.A., Belgian Congo

Introduction by Professor C. W. Wardlaw, Professor of Cryptogamic Botany in Manchester University

In the following article, Mr. S. de Blank has made a reasoned appeal for co-operation in oil palm research. On the basis of personal experience, I support him fully in the views which he has expressed. When I first had occasion to look into the problems of oil palm cultivation some seven years ago, I was astonished that so very little was known, both scientifically and practically, about this important crop. Major diseases awaited diagnosis, as, indeed, some still do; the causes underlying various kinds of crop failure were completely obscure; and little was known of the fertiliser requirements of cultures on different soil types. Work on selection and breeding, however, was making good progress and had emerged from the initial exploratory phase. On the basic phenomena of crop physiology, on the other hand, it would have been difficult to indicate a single major contribution. Even the distribution of the root system has only recently been investigated.

As it seems to me, there can be little doubt that, in the future, the oil palm is likely to be cultivated on a very considerable scale throughout the tropics both of the Old and New Worlds. The palm, as we know, flourishes and produces abundantly on good rich soils; but more important, perhaps, is the fact that it also yields economically important crops on rather poor ones, much of the African production being obtained from such sources. When, in relation to world needs, the cultivation of the oil palm is extended—and this process is going on now—the new areas will comprise soils of all grades of fertility, but many of them will be initially poor, or will become so. In the new phase of palm cultivation, it will be certainly highly desirable, if not essential, to make the best use of the resources of science as applied to agriculture. Thus stated, one becomes aware of how much there is to be done, how few experienced and competent agricultural scientists there are at present available for work in the tropics, and how expensive they are to maintain there. But, to make the best use of the available scientific resources, there is a way out—by a co-operative effort among all who are interested in this important crop. I recognise that considerable time and effort will be needed before this desirable aim can be realised. But at least a beginning can be made now—by giving the idea publicity in a journal of wide and representative interests.

C. W. WARDLAW

DURING the last 50 years, the oil palm (*Elaeis guineensis* Jacq.) has become one of the world's main sources of vegetable oil. Some oil from the indigenous palms on the west coast of Africa was first exported in the year of the Spanish Armada, but the big commercial production is a feature of the present century. By 1939, the annual world exports had expanded to some 500,000 tons of oil and 650,000 tons of kernels, and these quantities seem likely to be exceeded in the near future, provided peaceful conditions admit of normal production in the Far East. Quite considerable quantities of oil, not included in the above records, are consumed in the producing countries where, as in Nigeria and the Belgian Congo, palm oil constitutes an important part of the diet. During the last 100 years, the oil palm has been introduced into other territories, notably Sumatra and Malaya, where it has proved very successful. It seems probable that there are extensive areas in other parts of the world where the oil palm would thrive, and it is not impossible that its cultivation may in the not-too-distant future assume considerable proportions in the New World tropics.

Importance of the oil palm

In view of the actual and potential value of palm oil in the world's food and industrial economy, the sum total of knowledge of the scientific cultivation of this crop is very inadequate and compares unfavourably with that relating to other perennial tree-crops, such as Hevea and citrus, or annual tropical crops, such as cotton, groundnuts and sugar-cane. Thus far, the greatest concentration of effort and the biggest advances have been on selection. Here important progress has been made in all the major producing countries, but on many other aspects a great deal still remains to be learnt. The existing large plantations afford an admirable basis for obtaining the new information which alone can assure the sustained well-being of this agricultural industry.

Earlier developments

Just before and during the early years of the last war, the large plantation industry both in Africa and the Far East was considerably extended and this process continues. A number of disturbing features, inimical to production, soon made their appearance, particularly in Nigeria and the Belgian Congo, but under war conditions little could be done. By the end of the war, it had become evident that strenuous scientific efforts would be needed if the large plantations were to be made as productive as they should be. The necessary impetus was given in a widely circulated private report, prepared by Professor C. W. Wardlaw of the University of Manchester, after his visit to the Belgian Congo in 1946 at the invitation of the United Africa Co. Ltd., London. In this report, an analysis was made of the serious and complex disease situation in some of the extensive Belgian Congo plantations, together with an indication of the general research effort that would be

needed to maintain oil palm cultures in a state of health and productivity commensurate with the value of the crop. Further work has shown that these findings have a general applicability to the whole Central and West African oil palm belt. Briefly, the relevant researches include:

(i) Soil studies to investigate problems of fertility and the methods to be adopted for raising the fertility status of African soils.

(ii) Agronomic investigations to determine the optimal conditions for growing healthy, productive palms.

(iii) Investigations of the incidence and nature of the considerable number of major diseases and pests.

(iv) Seed selection with a view to obtaining disease-resistant, highly-productive strains of palms, adapted to local soil and climatic conditions.

(v) Physiological studies of growth from the ungerminated seed to the adult state.

Need for further research

In short, research both of a fundamental and applied character is urgently needed on all aspects of oil palm cultivation. There is almost unlimited scope for new work of fascinating interest, with the added incentive that many of the problems are common to the vast palm-growing areas of West and Central Africa. Fortunately, institutions such as the I.N.E.A.C. in the Belgian Congo, the West African Institute for Oil Palm Research at Benin, Nigeria, the I.R.H.O. Research Stations at La Mé,

A 7-year-old plantation palm, showing how the bunches form

Pobé, Dabou and Sibiti, the oil palm research work at Serdang, in Malaya, and others are getting into their post-war stride and considerable progress may be expected in the next few years. Each institution has, of course, its own particular research aims, but in general these include both fundamental studies of soils and crops and selected topics of an applied character. The large plantation companies, on the other hand, naturally concentrate on their own domestic problems, and are primarily interested in scientific work that is likely to be of immediate practical importance—*e.g.* the improvement of soil fertility, the control of diseases and pests, etc. Many of the large plantation companies are, in fact, employing their own scientists and some good work is being done.

Need for co-operation

In view of the considerable research effort that is needed to make the most of the oil palm as a source of vegetable oil, and having in mind that programmes of research are now being undertaken by institutes and by private enterprise in different parts of the world, that the total number of scientists available for this work is small, and that duplication of work in different centres is wasteful, it is surely desirable that an attempt should be made to achieve some system of co-operation.

The kind of arrangements that should be encouraged in the common interest might include close co-operation between all research workers in any particular territory; and full and early publication and exchange of information between all oil palm-growing countries. Few will deny that these aims deserve careful consideration. How they can be achieved is clearly a matter of common interest. Here, in a purely tentative fashion, two aspects may be considered, co-operation within an individual palm oil-producing region, and the wider co-operation in the exchange of information connoted above.

In any particular region, frequent exchanges of views and information on research matters between the interested parties, including early indications from work in progress, and proposals for new investigations, will be of very real value. Annual or biennial conferences are, of course, among the recognised means by which these aims could be achieved. It would be reasonable to expect that official research institutes would take a leading part in organising these conferences, but the venue could be changed from year to year to include both official and private centres of research. In the actual conduct of research it will evidently be advantageous if the specialists employed by private companies can, as far as possible, collaborate with the official institution, thereby extending an agreed programme of work to a wide range of conditions. Lastly, as experience has often shown, it will be helpful to an institute's specialists for them to become fully acquainted with practical plantation problems. With good-will on all sides, there seems to be no good reason why this regional collaboration should not be realised.

Inter-territorial co-operation

The larger aim, *i.e.* the exchange of information between all interested coun-

Forest oil palms in the Belgian Congo

Selected palms being mated by controlled artificial pollination

tries, presents greater difficulties and is likely to prove more difficult to bring to fulfilment. As the pooling of all available information and its dissemination to all interested parties is the ultimate aim, the creation of an International Oil Palm Bureau seems likely to be the most practical means of achieving this aim. Such a bureau would have as its function the collation and distribution of reports and the periodic convening of international conferences. The staffing and financing of the bureau would have to be agreed upon by the countries interested. Actually the number of staff required need not be large, although language difficulties would have to be taken into account. The financial aspect could most simply be met by contributions from the interested governments, possibly based on some such criterion as the production or the export of palm oil and kernels. The full implications of an innovation of the kind suggested cannot be adequately dealt with in this short article, but the ultimate need for some central body may be duly emphasised. The need for closer international cooperation in oil palm research is pre-eminently desirable and any move that can be made in this direction should be encouraged. An essential first step would be to obtain the interest and approval in principle of the interested government and directorates of the private companies; and if, as a parallel development, some central institution could be convinced of the desirability of the project, and encouraged to take the initiative, the whole conception might well advance to the point of substantial realisation.

Position in Africa

So far as Africa is concerned, the question of the creation of an Oil Palm Bureau might be regarded as falling within the sphere of interest of the recently created Scientific Council for Africa, South of the Sahara. This organisation has already created similar bureaux of information on matters of inter-territorial interest such as trypanosomiasis, soils and land use, and epizootic diseases. If the functions and terms of reference of such a bureau could be extended and the requisite co-operation obtained from *all* the palm oil-producing countries in the world, a big advance would have been made.

Conclusion

In the foregoing, attention has been drawn only to the desirability of co-operation within territories and internationally in matters of oil palm research. The bringing together of all new knowledge, as a steady stream of reports flowing into a common pool for the common good, would be a desirable beginning. But very soon it would become evident that co-operation alone is not enough if oil palm research is to advance at a high scientific level. Some integration of the data would be seen to be essential. This implies the services of a biologist capable of integrating, *i.e.* of bringing together in their proper biological relationships the several kinds of data that help to explain the phenomena of growth, productivity, disease, etc. This conception, which to some readers may seem no more than a scholar's dream, would, in fact, be one of the main justifications for the proposed central bureau.

Example of a palm tree suffering from wilt and armillaria

Oil palm research, like so many other subjects, has undoubtedly suffered since the war from a lack of trained scientists. To encourage a wider interest in these problems among university graduates it is suggested that research fellowships, tenable for two or four years at a recognised tropical institute or research station, should be made available. Selected applicants would be expected to work on definite problems and to publish their results. In this way research workers would become interested in the problems of the oil palm and would find, in this little-worked field, opportunities for making substantial contributions to scientific agriculture.

Photos: United Africa Co.

South Pacific Conference

Over 60 delegates representing 18 Pacific island territories assembled at Noumea recently to attend the opening of the Second South Pacific Conference. It was held at the headquarters of the South Pacific Commission, of which the conference is an auxiliary body, set up to provide a direct link between the Commission and the island peoples it serves. The conference, which lasted ten days, was under the chairmanship of M. Lassalle-Séré, senior commissioner for France to the South Pacific Commission.

During the conference, the delegates, drawn from the most part from the indigenous peoples of the South Pacific, reviewed the progress that the Commission, with its member governments and their territorial administrations, has made in promoting the welfare of their peoples since the first conference was held in Suva in April 1950. Delegates also discussed problems common to all Pacific territories, such as the conservation and improvement of land and sea resources, the relation of population to resources, marketing problems, the role of women and women's organisations in the community, and the health education of island peoples.

Major D. M. Macmillan

We learn with regret of the recent death of Major D. M. Macmillan, Director of the Agricultural Department of the British Council and Editor of the *British Agricultural Bulletin*.

Aldrin and Dieldrin

PART I

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Of the numerous synthetic insecticides which have made their appearance in the last few years none have attracted more attention and given promise of a wider range of applications than the two Hyman insecticides aldrin and dieldrin. This article and one to be published next month summarise the characteristics and uses of these two compounds.

IT is now over four years since Dr. Julius Hyman, of Denver, U.S.A., announced the discovery of two new and potent insecticides, *Compounds* 118 and 497, which later were to be given the common names *aldrin* and *dieldrin*. These new materials, relatives of chlordane, are, like the latter, derived from the hydrocarbon cyclopentadiene by a modification of the German Diels-Alder reaction, well known to chemists, and it is appropriate that this reaction should give its name to the new chemicals.

Since their discovery, aldrin and dieldrin have grown in importance at a remarkable rate, so that their production and consumption world-wide are now measured in thousands of tons annually, while they have been applied to millions of acres. This growth stems from the fact that both insecticides possess a wide range of uses and their extremely low dosage rate per unit area make them, for many purposes, highly competitive in price with the older materials, DDT and BHC.

Aldrin

Aldrin, when relatively pure, is an off-white crystalline solid, and is substantially odourless. It is officially defined as a material ' containing not less than 95% of the compound 1, 2, 3, 4, 10, 10-hexachloro-1, 4, 4a, 5, 8, 8a-hexahydro-1, 4, 5, 8-endo-exo-dimethanonaphthalene and 5% or less of insecticidally active related hydrocarbons.' It is available commercially as technical aldrin, a dark, rather waxy solid and also as *Aldrin* 60, a dark-coloured oily liquid containing 60% by weight of aldrin. These materials can be formulated to give a range of dusts, wettable powders and emulsible oils. Aldrin 60 is miscible in all proportions with ordinary paraffinic and aromatic solvents; it is also formulated with emulsifiers in such a way that it becomes readily miscible with water and then becomes a highly concentrated and convenient form of the material for certain operations such as aerial spraying for locust control.

Dieldrin

Dieldrin is officially defined as a material ' containing not less than 85% of 1, 2, 3, 4, 10, 10-hexachloro-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8a-octahydro-1, 4, 5, 8-endo-exo-dimethanonaphthalene and 15% or less of insecticidally active, related compounds.' Dieldrin is marketed for formulation purposes as *flake dieldrin*, a buff-coloured, almost odourless, crystalline material. Flake dieldrin is ground with diluents such as talc or kaolin to give dusts or water-dispersible powders of high concentration.

TABLE 1—SOLUBILITIES

	Solubility in grammes per 100 ml.	
	Aldrin (at 30° C.)	*Dieldrin (at 26° C.)*
Acetone ..	159	54
Benzene ..	350	75
Hexane ..	98	7·7
Methanol ..	9	4·9
Xylene ..	235	52

Properties

Aldrin and dieldrin are both virtually insoluble in water, which dissolves at 26° C., 0.07 parts per million of aldrin and 0.05 p.p.m. of dieldrin.

Aldrin and dieldrin are both relatively non-volatile. Work with pure, re-crystallised material, using the Langmuir effusion method,[1] shows that aldrin is rather more volatile than gamma BHC (lindane). Dieldrin and DDT are both very much more persistent than aldrin or BHC. In practice, of course, other factors operate and in the soil aldrin is more persistent than its behaviour when exposed to air and sunlight would lead one to suppose.[2]

As stated above, both aldrin and dieldrin are derived from cyclopentadiene, a hydrocarbon found in small quantities in distillates from coal-tar or ' cracked ' petroleum. At the present time, the manufacturing process is carried on only at Denver, Colorado, U.S.A. Plans to make aldrin, dieldrin and related chemicals outside the U.S.A., however, are now far advanced.

Growth of popularity

The properties which have led to the rapid and outstanding growth in the use of aldrin and dieldrin are primarily their extremely high insecticidal effectiveness, cheapness per unit area treated, high stability, especially in the presence of alkalis, and their freedom from tainting qualities. They are also, in themselves, entirely non-phytotoxic and are compatible with almost all the common agricultural chemicals, including fertilisers. An examination of numerous field reports shows that aldrin and dieldrin both possess an insecticidal efficiency for many purposes comparable with that of the gamma isomer of BHC (lindane), aldrin having the same and dieldrin rather higher efficiency. In comparison with technical BHC (12-13% gamma), therefore, both aldrin and dieldrin are eight to ten times more active and this is also true when they are compared with DDT. The importance of this extreme activity is obvious when consideration is given to factors such as insect resistance; the problems of residues, the cost of transport, and the very low dosages required enable the cost per unit area treated to be kept to a figure which is often lower than that applicable either to DDT or to BHC. A further most valuable property of both aldrin and dieldrin is stability in the presence of alkalis. It is well known that both DDT and BHC undergo decomposition—dehydrochlorination—and inactivation when in contact with alkaline substances, and this limits their usefulness for a number of purposes. Thus, although the older insecticides cannot be mixed with certain fertilisers and stored for any length of time, owing to the possibility of decomposition, both aldrin and dieldrin are reasonably stable in mixtures of this kind and their use in this connection is increasing very rapidly, particularly when pests such as wireworm, chafer grub, ants, corn (maize), rootworm and white-grub of sugar-cane (*Diaprepes* sp.) are to be controlled. For application to soil, rather special problems

Treated (*right*) and untreated (*left*) maize; aldrin used at a rate of 1½ lb. per 100 lb. fertiliser

are involved, in that a small quantity of insecticide requires to be mixed with an enormously greater volume of soil. Soil insects are not easily controlled with DDT used at economic dosage rates, and with BHC there is always the danger of taint, especially with susceptible crops such as potatoes. It is because the Hyman insecticides are alkali-stable, persistent in soil, highly insecticidal and non-tainting, that they possess extreme value as soil insecticides, in both temperate and tropical climates, and they offer new and remarkable possibilities for greater crop production.

Commercial application

Commercial development in the use of aldrin and dieldrin has, naturally enough, gone forward to the greatest extent in the United States, a country which is still estimated to use rather more than 50% of all the world's supplies of insecticides. In the sphere of cotton insecticides, aldrin and dieldrin have made great headway and are outstanding products for the control of cotton boll weevil—*Anthonomus grandis* Boh. Another great success for aldrin has been achieved in the fight against grasshoppers which infest vast areas of the Mid-West States as well as the prairie provinces of Canada. The area to date treated for grasshopper control exceeds 3 million acres in the U.S.A. and Canada, the amount applied being at the astonishingly low rate of 2 oz. of actual aldrin per acre. Much of the application has been from aircraft, and in Canada the operation was in the hands of the Government. Apart from cotton insects and grasshoppers, successful field work has been carried out against a very large number of insects of economic importance in the U.S.A., and the literature already totals hundreds of papers. Official approval for the use of aldrin and dieldrin has been obtained for many pests and notably for alfalfa (lucerne) weevil, ants, cabbage maggot, wireworm, leaf-miners, thrips, plum curculio, armyworms and cutworms, strawberry and black vine weevil, and corn-rootworm (*Diabrotica longicornis* Say.), together with houseflies, stable-flies, mosquitoes, ticks, fleas and mites (chiggers). The use of aldrin-fertiliser mixtures is extending rapidly and special equipment has been designed for this use. The work carried out with alfalfa weevil (*Hypera postica* Gyll.) is of particular interest in that this pest could not be readily controlled until the technique was developed of using dieldrin in the early spring just before growth commenced; dieldrin now gives outstanding control. Further, aldrin and dieldrin seem likely to prove to be the best materials available for ant control and, apart from the United States, numerous experiments are now in progress in various countries and notably in Italy (Argentine ant, *Iridomyrmex humilis* Mayr.) and Brazil ('sauva' or leaf-cutting ant, *Atta* spp.) to establish the most efficient means of applying the insecticides.

Control of flies and mosquitoes

Many trials have been made in the United States to test both aldrin and dieldrin for the control of insects such as the mosquito and house-fly. In an early report, it was shown that the relative toxicities of various insecticides against the larvae of the mosquito, *Aedes aegypti*, compared with DDT taken as 1.0, were dieldrin 7.50, aldrin 5.0, lindane 0.80 and chlordane 0.25. The actual amounts of toxicant required to give 100% mortality of the larvae were, in parts per million parts of water, DDT 0.05, dieldrin 0.0065, aldrin 0.01, lindane 0.06 and chlordane 0.02. In the case of the house-fly, a new technique[3] has been worked out, employing strips of wire gauze, dipped in a dieldrin emulsion and dried. These strips are stapled, using a pistol-type stapler, to the ceiling of dairy barns. In one test, strips were treated with a 15% dieldrin emulsion and stapled 24 in. apart in a room (8 ft. by 20ft. by 15 ft.) and 20,000 flies were released in the room. All the flies were dead within 12 hr. and the strips were clearly seen to be attractive temporary resting-places for the flies. In actual use, good control of flies has been achieved for over three months after the strips have been placed in position and the method shows great economy in the quantity of insecticide required. Flies which are resistant to DDT quickly acquire resistance to dieldrin, however.

Locust control

In the past three years, very many field trials have been carried out, in over 60 countries, to test the value of the Hyman insecticides for the control of both temperate climate and tropical crop pests as well as insects conveying disease to man. A noteworthy triumph has been secured by aldrin employed in the campaign against the desert locust (*Schistocerca gregaria* Forsk.) and many tons of aldrin have been used. Aldrin 60 has been diluted with gas-oil or water and sprayed with great effect by aircraft in Iran, Iraq, Pakistan and India particularly, and is being so used at the present time in Ethiopia and Somalia. All this work has been carried out by Governments and by 'Point 4' personnel, assisted by the Food and Agriculture Organisation of the United Nations. Work in 1952 has also established the extreme value of aldrin as a locust bait. The insecticide (Aldrin 60 or Aldrin

This man is holding ears from aldrin-treated maize in his right hand, and untreated maize in his left

40% wettable powder) is mixed with rice hulls or wheat bran or similar material to form a wet or dry bait. The proportion of insecticide required is very low; 2 oz. of actual aldrin are used for the preparation of 100 lb. of bait. The material is distributed in such a manner that it is eaten by the locust ' hoppers,' the rate of application being 10-20 lb. of bait per acre, according to circumstances. Complete control of the hoppers is obtained after a few hours either by spraying or by baiting and exhaustive tests have shown that the operations can be carried out without danger either to man or to livestock.

Third and fourth stage locust hoppers on an island in the Tigris River, in the Mosul area of Iraq

Dieldrin as a wall spray

In the case of mosquito control, the widespread use of DDT has already led to the development of certain cases of resistance to this insecticide, and BHC is insufficiently persistent for an ideal house-spray for adult mosquito control. Dieldrin has been shown to be extremely effective as a spray applied to walls and roofs at very low dosage rates (of the order of 12-50 mg. per sq. ft.) and to have persistence extending over many months; it is also considerably cheaper to use than DDT. Further, dieldrin has been used in a special granular form with considerable success for the control of mosquitoes breeding in rice-fields.[4] A number of important official trials are now going forward or are planned for 1953 and it is believed that dieldrin may well replace the older insecticides in time. The extremely lethal nature of dieldrin to the mosquito and its lack of the irritant effect exhibited by DDT will help to prevent the build-up of resistance, since a very short contact time will kill the insect when dieldrin is used.

Other problems

Other important problems which may now be solved with aldrin and dieldrin are the control of the widespread pests olive fly (*Dacus oleae* Gymm.) and the Mediterranean fruit fly (*Ceratitis capitata* Wied). Work on these pests is going forward in a number of countries and notably in France, Spain, Italy, Greece and Israel. Excellent results have already been achieved in France in the control of the chafer bug (*Melolontha melolontha* L.)[5] and dieldrin, with or without a copper fungicide, is being widely used for the control of Colorado beetle in Switzerland. In Kenya, it has been shown that dieldrin emulsion painted on the stems will prevent ants gaining access to coffee and control of the mealy bug associated with the ant has followed. In Cuba and other areas in the Caribbean and in the Canary Islands the

Cotton bollweevils perforating the boll

banana borer (*Cosmopolites sordidus* Germ.) is completely controlled with dieldrin,[6] and this is true also of the sweet potato weevils, *e.g. Rhyssomatus* sp.[7] The latter pests can destroy up to three-fourths of the crop (*Ipomoea batatas*) in North, Central and South American areas.

Mammalian toxicity

The introduction of any new insecticide poses, of necessity, questions regarding its toxicity to man. The hazard, if any, attached to the new material requires to be examined from two major points of view. These are the question of the safety of the farmer or operator who is to handle the new chemical and the question of the hazard to the health of the individual who consumes the crop in one form or the other. The latter involves the question of residues, and the determination of these residues.

In the past four years, a very considerable volume of work has been carried out to examine the nature of the hazard attached to the use of aldrin and dieldrin. Laboratory work has shown that both insecticides are more toxic to laboratory animals than DDT, although very much less toxic than parathion or arsenic compounds, such as lead arsenate. On the other hand, both aldrin and dieldrin are used at much lower dosage rates than DDT and it is, therefore, not surprising that although many millions of pounds of both insecticides have been applied, no known fatality from aldrin or dieldrin has been reported. There have been, in fact, following the use of aldrin and dieldrin, fewer than 20 bona-fide cases of illness reported and most of these have been the result of accidental, or in some cases, intentional ingestion. The position has been admirably summarised by Princi recently.[8]

Future development

It may be concluded that aldrin and dieldrin will repeat the pattern of development shown by DDT, the first modern synthetic insecticide. In the case of DDT, there were many early apprehensions regarding its toxicity to man and many elaborate trials were carried out to determine the degree of this toxicity. The demands of war and the unique nature of DDT at the time of its discovery led to an unprecedented rate of development which, in turn, rapidly answered questions regarding the hazards attached to its use. Today, proper precautions must be taken with any new insecticide and its use should be regarded as involving a hazard until the contrary is proved. It is clear from the experience now available regarding the use of aldrin and dieldrin in the field that the materials can be employed with safety provided commonsense precautions are taken similar to those which should be used with any chlorinated hydrocarbon insecticide. This applies, of course, particularly to the concentrated materials.

Residual effects

The question of residues in crops treated with aldrin or dieldrin or grown in soils treated with these insecticides has been most carefully studied. Techniques have been worked out to enable extremely small quantities of the insecticides to be determined. Thus, using a bio-assay method in which the test insect is a fruit-fly (*Drosophila melanogaster* Meig.), Pankaskie and Yun-Pei Sun have shown[9] that it is possible to determine both aldrin and dieldrin with a sensitivity of 0.1 parts per million. Micro-amounts of aldrin and dieldrin can be determined also by infra-red spectroscopy[10] and Danish and Lidov[11] have given details of a useful colorimetric method for aldrin.

In general, it is found with aldrin and dieldrin, as with DDT and BHC, that unacceptable residues on fruit (apples, citrus, olives) can be avoided by the proper timing of the spray or dust. For many purposes, *e.g.* the control of pests of Brassicas grown for seed, and the control of Colorado beetle, the question of residues does not arise, except that it is important to know whether residues in the soil can be absorbed by the plant. These residues in soil might arise from a build-up following frequent applications to the aerial parts of plants such as potatoes, or will be present following the deliberate mixing of the insectides, *e.g.* aldrin, with the soil for soil insect control. Since aldrin is being used for this latter purpose at a rapidly expanding rate, an exhaustive investigation has been carried out by co-operation between Federal and State experiment station personnel in the United States, Shell Chemical Corp. and Julius Hyman and Co. (Julius Hyman and Co. Division of Shell Chemical Corp.). A report[12] of this work has been issued; it shows that a number of representative crops—wheat, maize, rye, sugar-beet, sugar-cane and groundnuts—grown in soil treated with aldrin at dosages ranging from 2 oz. to 60 lb. per acre, do not absorb the aldrin, which cannot be found within the edible part of the plant even by techniques capable of detecting 0.1 part per million of aldrin. This non-absorption is true also of potatoes.[13]

Conclusion

It is not possible in a paper of this nature to indicate other than in outline the properties and usefulness of aldrin and dieldrin. This article will be followed by others giving a more specific account of certain fields of use of the new insecticides. It may be concluded without any doubt, however, that the versatility, effectiveness, cheapness and relative harmlessness of aldrin and dieldrin will enable them to achieve a place among agricultural chemicals comparable with that already achieved by DDT and BHC, and in so doing, these insecticides will make a notable contribution to the business of producing the world's food.

(The second part of this communication will appear next month.)

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MSA Fertiliser Demonstrations in the UK

Last year, the Government laid down a production policy which aims at raising output to at least 60% above pre-war by 1956. Illustrations of what is wanted are raising grass production by 15%, increasing the tillage area, raising yields and expanding livestock production all round. One of the keys to the situation is higher yields of both grass and tillage crops. Greater use of fertilisers by farmers will be one of the most important means of achieving these increases; that is why the Government re-introduced the fertiliser subsidy last year. The increase in production that can be achieved by the use of lime and fertilisers can be readily demonstrated. To assist this country, the London Mission of the American Mutual Security Agency has offered funds amounting to some £41,000 towards the cost of a series of demonstrations on farms throughout England and Wales.

This offer has been accepted and the demonstrations will be organised by the National Agricultural Advisory Service. They will be related to local conditions and their purpose will be to show to farmers the value of improved fertiliser practices and better management in increasing the production of grass, fodder and cereals. It is hoped that it will be possible to arrange for fairly large-scale demonstrations on between 300-400 farms.

There will be four types of demonstration. First, there will be those in which the emphasis will be on proper lime and fertiliser applications for grassland improvement—including the use of weedkillers on land which could only be ploughed and re-seeded to grass with difficulty, if at all. Then there will be those where the value of intensive management of existing temporary and permanent grassland will be shown, with emphasis on rotational grazing. This type of demonstration is intended for grasslands with a good sward but whose potential output could only be developed by intensive methods of grazing management and more liberal fertiliser applications.

The third type will compare the results obtained from ploughing up and re-seeding, using improved seed mixtures, good cultivation and suitable fertiliser treatment, with the results from improvement of existing grassland by surface treatment and fertilisers. This type of demonstration is intended for grassland where ploughing up and re-seeding has proved more satisfactory than renovation of the existing sward. The fourth type of demonstration will show the results from most effective application of fertilisers compared with usual fertiliser application and with no fertilisers at all. These demonstrations will be carried on mainly in arable areas on farms where optimum fertiliser applications are not the rule.

Southern Rhodesian Fertiliser Prices

Fertiliser prices in Southern Rhodesia have recently been reduced. The reductions vary from £1 12s. to £6 5s. 9d. a ton for compound fertiliser and from £3 7s. 3d. to £7 0s. 6d. a ton for straight fertilisers. For example, compound-A granular fertiliser—used for Virginia-type tobacco—will cost £24 15s. 3d. per ton, a reduction of £6 5s. 9d., and compound-D granular fertiliser—used for maize—£19 19s. per ton, a reduction of £1 12s. Sulphate of ammonia—used for maize—will cost £30 per ton, a reduction of £7 0s. 6d., and sulphate of potash—used for tobacco—£30 19s. 3d., a reduction of £3 7s. 3d.

Rice in North Australia

GEORGE FARWELL

Once regarded as the 'forgotten child' of a nation primarily concerned with developing its highly industrialised cities, the tropical north of Australia is beginning to come into its own. Government committees and private enterprise have both been assessing its potentialities.

THAT the development of the north is one of the most important problems facing Australia, was one of the conclusions of the report of a joint Western Australian and Federal Government committee which investigated the Kimberleys in 1951. The committee urged, among other things, that greater attention should be paid to tropical agriculture. Although this report was concerned only with the Kimberleys Division of Western Australia, the comment is equally valid for the Northern Territory.

Tropical Australia

Australia's tropical belt covers the best part of a million square miles, extending from the north-west coastline of Western Australia, across the Northern Territory to the coastline of Northern Queensland. Only in Queensland has there yet been any large-scale development, for its sugar industry is worth well over £A 10 million annually and west of the Great Dividing Range some 4½ million head of beef cattle are pastured. The Northern Territory, with 1 million cattle, has also considerable mineral resources, and recent uranium discoveries there look like yielding rich dividends. The Kimberleys have little to offer, apart from a pearling industry and half a million head of cattle.

Cattle-raising and mining alone can never attract much of a population, and people are what the tropical north needs if ever it is to be properly developed and its many acres of fertile land made fully productive. Scientists have been at grips with these problems since the last war. There can be no easy solution, however, in a land which has to endure fierce heat, the torrential rains of summer, long dry winters and periodic drought. There is besides no precedent for large-scale agriculture in such an environment which, in its general characteristics, resembles that of West Africa's monsoonal belt. There are, though, urgent reasons why something should be done, for the rapid growth of Australia's population in the post-war years has set a strain upon her food resources. There are also important export markets to consider.

Prospects for rice growing

A significant move was made in October 1952 when the Northern Territory administration announced that experiments were under way to test the possibilities for the growing of rice. Three experimental farms have been established in the Darwin area. One of these, known as the Chinese Rice Gardens, is near Pine Creek, an abandoned gold-mining town 150 miles south of Darwin. Fifty years ago thousands of Chinese lived and worked there, prospecting for gold, building the Darwin-Birdum railway line, and growing vegetables. Naturally, they also grew rice although only in sufficient quantities for their own needs. Since their departure, no attempt at rice-planting has been made. The new farm at the Rice Gardens will test 10,000 acres of soil, which may well grow rice in commercial quantities.

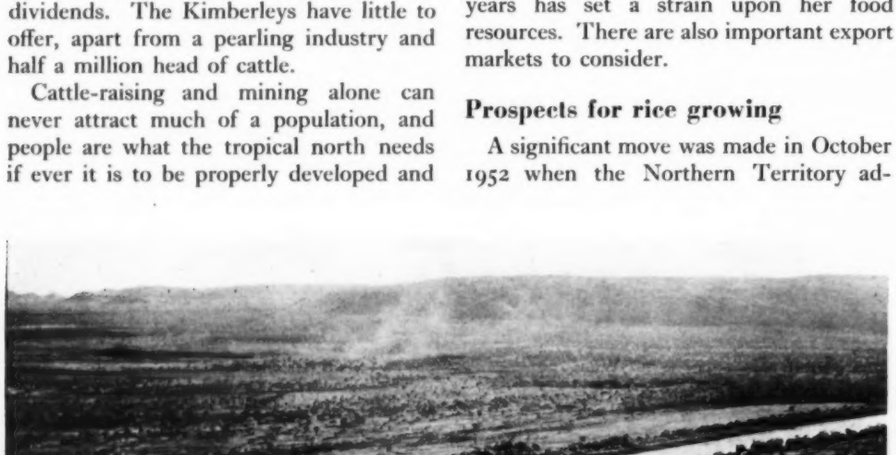
The other two farms are nearer the coast of the Timor Sea, on plains irrigated by the Adelaide and Mary Rivers. During the monsoonal wet season, which lasts from November to April, millions of acres are flooded. The swampy country at present supports large mobs of water buffalo, offering a considerable source of revenue to professional hunters who market their skins in the southern capitals. It may well prove to be suitable country for growing rice.

Humpty Doo Farm, 40 miles south of Darwin, will test the possibilities on more than 1½ million acres of clay soil types taken from the coastal plains which extend for some 200 miles between Arnhem Land, an aboriginal reserve, and the Daly River, while the Sixty Mile Farm, nearer Adelaide River, will make tests from 200,000 acres of what are known locally as *bulldust* plains. 'Bull' is a local colloquialism for plenty, the dust being actually the fine alluvial silt deposited by river floods.

Should the experiments prove successful, experts believe that about 2,000 farms could be established on the coastal plains alone, attracting a new population of more than 8,000 people. This would be an important addition to the small number of whites now inhabiting the Northern Territory.

Absence of need for irrigation

An important feature for such a project is that no large-scale system of artificial irrigation would be needed as the average annual rainfall is from 45 to 60 in., all falling in the wet season. In a report on the possibilities of rice-growing in the Northern Territory and the Kimberleys, Mr. W. Poggendorff, Chief of the Plant



The only agricultural project operating in the Kimberleys at the present time is the Kimberley Research Station, situated on the eastern bank of the Ord River near the Carr Boyd Range, which has a fine dam site for future irrigation works

Division, New South Wales Department of Agriculture, states that a very large proportion of the world's rice is produced under conditions of periodic flooding, on the plains and delta lands of the rivers of Southern and Eastern Asia, in the absence of any major irrigation works. Varieties and methods of culture are adapted to suit the local circumstances. The problem under consideration, however, is that of producing rice and initiating agriculture in these areas of Northern Australia, which appear eminently suited to the purpose, by the most economic means.

Kimberley Division prospects

In the Kimberley Division of Western Australia, similar investigations are also being carried out. Only half of this mountainous region of 125,000 square miles has so far been occupied—mainly for the grazing of beef cattle—but it has several large rivers and wide alluvial plains. The total rainfall varies between 20 and 40 in., again falling only in the wet season. The main hopes for agriculture lie along the great Ord and Fitzroy Rivers. Near Ivanhoe Cattle Station on the Ord River, 70 miles south of the port of Wyndham, the Kimberley Research Station has been in existence since 1945, experimenting with various types of crops and pastures. The farm is jointly run by the Commonwealth Scientific and Industrial Research Organisation, a body sponsored by the Federal Government, and by the Western Australian Department of Agriculture. The C.S.I.R.O. also has a dry-farming research station at Katherine, Northern Territory, 200 miles south of Darwin, concerned mainly with cotton, tobacco, peanuts and pasture improvement.

At the present time rice appears to offer the brightest prospects on the Ord River, but sugar cane has also been grown satisfactorily.

Progress and problems

The research station itself covers an area of 2,000 acres, though only a small portion of this has yet been utilised. The site was selected to include two main types of soil: the red levee soil of the river banks and the rich Conunurra clay, locally known as the black soil plain. How these soils will behave under continued cultivation and constant irrigation is not yet known. Irrigation is carried out by means of a small pumping plant on the bank of the river. The first rice crop was sown in November 1947 at the start of the wet season. It grew well, but before being harvested was entirely destroyed by white cockatoos, which inhabit this region in many thousands. By the end of 1949,

The Kimberley Research Station maintains this large vegetable garden, irrigated from the Ord River

three out of five rice-planting experiments had been destroyed in this fashion as well as other small plots growing rice of different varieties.

Cockatoos have indeed proved to be one of the worst of several pests which have to be overcome. The attempt to control them by putting nets over the rice was made, but what the cockatoos could not reach was swiftly devoured by small finches. These beautiful little birds are even more numerous and destructive than the cockatoos. Nevertheless, if rice were more widely planted, birds would no doubt do less damage. Kangaroos and wallabies which occur in great numbers have also made it imperative to fence experimental paddocks, while the grasshopper problem has not yet been overcome, these insects having in fact eaten their way through the crops like the proverbial locust plagues of Egypt.

Moreover, in 1952, the north was severely hit by drought. Nevertheless, scientists are reasonably well satisfied that rice can be grown in the Kimberleys, and the situation has been summed up by Mr. C. S. Christian, Officer in Charge, Land Research Division, C.S.I.R.O.: 'For quarantine reasons, we started off with varieties brought up from the Murrumbidgee Irrigation Area in New South Wales. They, however, proved quite unsuitable. We are now experimenting with tropical varieties. We think they will grow well, but the yield would probably not be so good as along the Murrumbidgee. Although rice throughout the world is most commonly grown in the tropics, the best producing areas are those far from the equator. The heaviest yields, for instance, are in Australia, Spain, Italy and California. Temperate and subtropical areas have, in fact, proved the best. It may well be that the length of the day has a major influence upon the productivity of these crops.'

Seed supplies

Australian rice areas are said to be free of disease and quarantine restrictions in Australia are very strict. This was why the initial experiments were made with rice from the Murrumbidgee irrigation area. Since then permission has been given for the importing of seed from New Guinea, where the Agricultural Department carries out tests on varieties brought from Malaya and the Philippines before giving them a clearance.

Fitzroy River development

Another rice-growing venture was scheduled to start in 1952 on the Fitzroy River. A private company, Northern Development Pty. Ltd., has leased 200 acres of alluvial flats from Liveringa Station, a million-acre sheep property some 100 miles south-east of Derby, main shipping port for the West Kimberleys. The company has been jointly financed by the Rice Equalisation Association Ltd., a group of rice millers in New South Wales, and by a cereal manufacturing firm.

A large quantity of heavy machinery was bought early in 1952 and blocks laid out with irrigation channels beside the Billabong, a backwater of the Fitzroy River. However, the unprecedented failure of the wet season in 1952 left the Billabong dry for the first time in history and the first

planting had to be postponed until April 1953. The rice to be used is a variety imported from the Southern United States.

In the immediate future, it seems probable that rice could be produced more effectively along the Fitzroy River than the Ord, for irrigation there could be carried on without the need of major engineering works. The Ord River Valley has at least 200,000 acres of alluvial plains of which a large proportion might support an agricultural community, but a big irrigation scheme would have to precede it. Since the dry season lasts from April to November, and the river does not run during most of that time, a considerable volume of water would have to be stored. A magnificent dam site exists in the nearby Carr Boyd Range and there has been talk for at least a decade of damming the great gorge carved through it by the Ord River, but its cost today would be at least £A 5 millions. The main question to be decided is whether it would prove economic to lay out so much capital to support 250 or 300 farms. Also, what would be the most paying type of crops?

Gieke Gorge, a deep and permanent waterhole on the upper Fitzroy River, has been suggested as a possible dam site for irrigation schemes, although experts believe its sides may be too porous for the storage of water

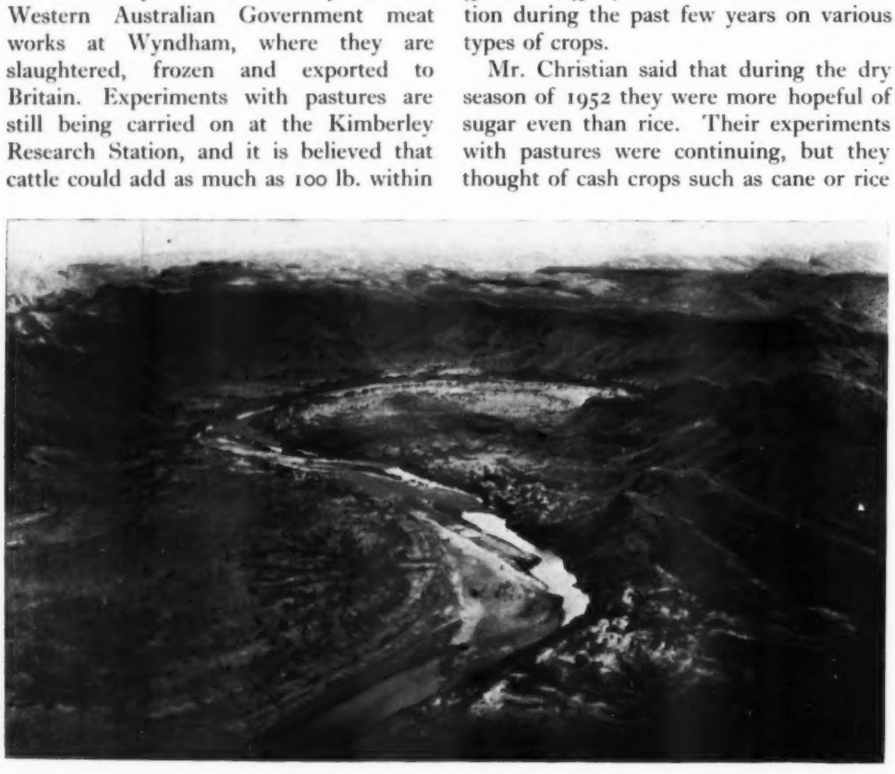
Alternative possibilities

Advocates of the irrigation scheme had in mind originally the growing of fattening pastures to top off beef cattle bred in the back country before delivery to the Western Australian Government meat works at Wyndham, where they are slaughtered, frozen and exported to Britain. Experiments with pastures are still being carried on at the Kimberley Research Station, and it is believed that cattle could add as much as 100 lb. within a month. Farmers, however, might find their return unsatisfactory. For instance, they might produce 400 lb. of extra beef in a season, by this means averaging, say, £A 6 to £A 7. But a sugar crop on a similar acreage might well yield from £A 60 to £A 70. Hence the concentration during the past few years on various types of crops.

Mr. Christian said that during the dry season of 1952 they were more hopeful of sugar even than rice. Their experiments with pastures were continuing, but they thought of cash crops such as cane or rice as the main form of land use, with rotation of pastures for cattle fattening, even for dairying perhaps, in some future time. These things were as yet hypothetical, but what they were trying to do was to arrive at a system of pasture types and a way of fitting them to the environment. This was something relatively new, for in no tropical region in the world with a low density of native population did they extensively establish irrigated pastures to grow stock. There was absolutely no precedent to go on, and that was why they had been moving cautiously.

As regards sugar cane, rice and sorghum, the evidence pointed to the fact that they should be successful. But they had not yet produced them on a commercial scale. The indications were that they would be suitable for rather intensive settlement and they would help to establish a community. Such a system of farming might well include other things too, for there were oil seed crops such as sunflower seed, safflower, sesame, linseed, peanut and other oil seeds. They might also add fibres like cotton. None of these had as yet been proved economic, but they had been started. They are not looking at them as a basis for settlement but as subsidiaries should farming be successful.

Meanwhile, this great valley carries no more than a sparse population of beef cattle run on stations of a million acres each.



Some 80 miles south of Wyndham, the Ord River cuts its way through the red mountains of the Carr Boyd Range, creating an ideal site for water storage to irrigate the Ord River Valley. Engineers have surveyed it and selected the dam site

Damming the Ord River Valley

The building of a dam in this spectacular gorge, hemmed in by sheer red cliffs, is

something to stimulate the imagination. There are, however, many other public works demanding priority in various parts of Australia; labour and materials are in short supply, and finance cannot be forthcoming without real prospect of success. The development of the Ord River Valley may have to wait a few years yet, but some day it must come, for Kimberley soils have proved their fertility in other ways. Nearly every cattle station has its vegetable garden beside some river, producing in quantity; tropical fruits like paw paws, mangoes and bananas grow with little or no attention, and many stations have lately put in a few acres of pastures for fattening stock, small-scale pointers towards what might one day be done in a major way. Throughout history men have pioneered the land by the grazing of cattle or sheep, developing it more intensively with crops that bring a larger population. Sooner or later Northern Australia must follow this pattern.

The world need for rice

There could be no better ally towards this end than rice. Before the war most of it came from Burma, Siam and Indo-China, which piled up an exportable surplus for the world's market of at least 6 million tons. Today that has dwindled to little more than 1 million tons, and the demand continues to grow.

The chairman of the Rice Equalisation Association, Mr. A. E. Symons, has stated that the possibilities of a vast agricultural development in North-West Australia and the Northern Territory are considerable. Indeed, it was probable that rice could do for that country what sugar had for Queensland. He went on to point out that it was the sugar industry which made possible Australia's defensive role in the South-West Pacific during the war against the Japanese. General MacArthur's counter-offensives were mounted from the well-developed ports along the North Queensland coast, all of them built originally for ships in the sugar trade. The air strips used by the Royal Australian Air Force and United States Army Air Corps were actually laid down by means of tractors and other equipment used in the canefields. Sugar has brought prosperity and stability to Northern Queensland.

Conclusion

No longer can it be said that Northern Australia is being neglected. The amount of survey work now going on should bear fruit in the not distant future. The leadership of this work has been taken over by the C.S.I.R.O., which has been carrying out invaluable work throughout Australia. In the tropical north, quite apart from its operations at Katherine and on the Ord River, it is now engaged in an ambitious land survey.

The job of this survey is to record facts about the country, and to assess the possibilities of land use and development. This involves the description of the country, topography, geology, soils, vegetation and climate. Lands have been classified in the Northern Territory and East Kimberleys, based on their inherent characteristics. This classification is felt to be a fundamental one and it becomes the basis for more detailed work. The country is subdivided into various land units called land systems, their possibilities are assessed, and those showing most promise are developed. The Darwin area of the Northern Territory has now been divided into 19 land systems. The potentialities of each have been recorded and more research will go into the most promising areas.

The survey of the East Kimberleys has also been completed, and work will later be done in the West Kimberleys, which includes the Fitzroy River basin where some preliminary work has already been completed.

Article and photos by courtesy of Australian News and Information Bureau.

Hybrid Maize—Progress in Europe

SIX years ago, West Europe's acreage under hybrid maize was nil. Then in 1948 the first Marshall Plan importation of American hybrid's was made for grain production—50 tons of seed for Italy. The following year this was increased to 2,000 tons. Last year, Belgium, France, Greece, Italy, the Netherlands, Portugal, Spain and Switzerland together had some 200,000 hectares under hybrid maize. Their agricultural production as a result went up by 250,000 tons, valued at an extra $23 million, and still higher figures are expected in 1953.

Among these eight countries, it is in Italy that hybrid maize has made the most sensational progress. During the early stages, demonstrators went from farm to farm trying to persuade the owners to change over to hybrids, and a considerable publicity campaign was carried out. Hybrid seed is dearer than any other grain seed, but farmers are ready to buy it. Less seed per acre is required and yield goes up by 25% to 30%. Although the name *ibridi americani* has stuck, the amount of seed that comes from the United States to Italy is now quite small. Instead, Italy is producing her own and last year had a total of 110,000 hectares under hybrids; this spring, the home production of seed, 4,500 tons, will alone be sufficient to sow 160,000 hectares.

European hybrids

Substantial progress has already been made, however, in the development of European and American-European hybrids, and the breeding work now in progress in several countries has been welded into a co-ordinated programme designed to serve European requirements with maximum effectiveness. This co-ordination is under the sponsorship of FAO. Thus England, for instance, in addition to its own maize research, is likely to benefit from using certain strains which may be developed in the present breeding programmes in the Netherlands, Northern France, Germany and Switzerland. The fact that her cool maritime climate makes Britain a marginal area for the production of maize for grain, particularly on heavy soils, has not deterred British farmers; it has even greater possibilities for use as a silage crop.

In Holland, Dr. Ferwerda of the Wageningen Agricultural University, tried out over 100 varieties which he obtained from countries as far away as the United States, Turkey and Spain, and with patient cross-breeding discovered some varieties that do well in the cool, Dutch climate.

Some 240,000 hectares, or a third of Greece's arable land, is under maize, and a greatly increased production could be obtained from this area by the greater use of appropriate hybrids. Experimental work in the Plant Breeding Institute in Salonika has identified several strains suitable for different parts of the country, and the current output of seed should put Greece on a self-sustaining basis as far as the Salonika plan is concerned.

In Yugoslavia, which is Europe's main maize-growing country west of the Iron Curtain, large-scale plans are being drawn up to foster the use of hybrids.

Meanwhile, the hybrid maize experts from such organisations as FAO, OEEC, UNRRA and MSA (and its predecessors), as well as the Ministries of Agriculture, that have gone wholeheartedly into this campaign in Western Europe, have ample reason to feel satisfied with the results—although they are by no means complacent. They fully realise that, although substantial progress has been made, only some 4% of the 6,000,000 hectares of maize grown for grain production is hybrid. A good start has been made and prospects are good; but there are many years' work ahead to develop this fully.

Development and Progress of Irrigation in the Union of South Africa

The following general account of the position in regard to the development of water resources for irrigation in the Union of South Africa, is based upon information supplied by the Irrigation Department of that territory.

IN this age of ever-growing demands on agriculture to provide food for rapidly growing populations, countries where agriculture is dependent upon irrigation are studying more closely than ever before to ascertain how their water resources can be developed by engineering projects to secure the economical application of water to the land. The earliest practice of irrigation belongs, of course, to ancient civilisations like Iraq and Egypt, while its use in South Africa probably does not go further back than the 300 years of European settlement; nevertheless, the Union is making its contribution. Physical and climatic conditions vary considerably throughout the country, so that whereas irrigation is unnecessary for most crops in portions of the coastal belt, the rest of the country requires irrigation for at least part of the year during most seasons, according to the type of crop produced.

The fact, too, that August, September and October are the most critical irrigating months for growing crops and also the season of marked deficiencies in rainfall and low-flow in streams, emphasises the importance of irrigation to the South African farmer. Underground water supplies from boreholes and wells are used for irrigation on small patches of ground throughout, but there are already signs of over-development in many districts with the consequent dangerous lowering of the watertable, and the practice is being discouraged in favour of reserving the supply, as much as possible, for domestic and stock use on farms.

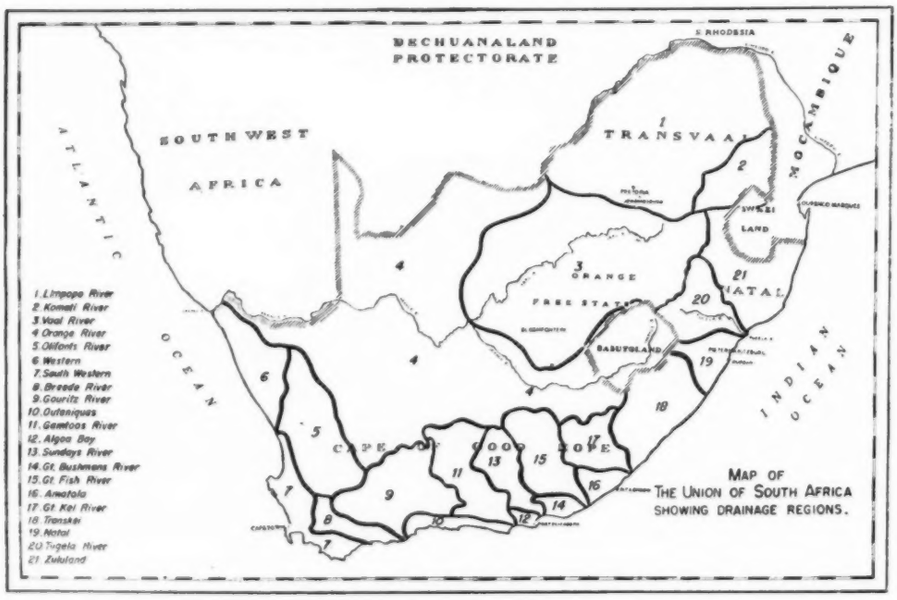
Physical features

With a surface area of roughly 472,000 square miles, the Union of South Africa lies at the southern end of the African continent between latitudes 22° 10′ and 34° 50′, and comprises four provinces: the Cape of Good Hope in the south, the central province of the Orange Free State, Natal on the eastern side of the coastal divide, and the northern province of the Transvaal. The Union is bounded by the Indian and Atlantic oceans except for its irregular northern land boundary where it adjoins South-West Africa, Bechuanaland, Southern Rhodesia, and the Portuguese territory of Mozambique.

An examination of the map showing the 21 main drainage regions of the country reveals its chief physical characteristics, namely, a vast interior plateau with an escarpment round its outer edge forming a watershed to the streams flowing through the coastal belt to the sea. This escarpment contains the highest parts of the country, rising to peaks approaching 11,000 ft. above sea level in that section of the Drakensberg Range forming the divide between the Vaal, Orange, and Tugela Rivers (see Regions 3, 4 and 10).

Undoubtedly the outstanding physical feature of South Africa is the relatively high elevation of its land surface which is made up primarily of a coastal plateau or flats at a low elevation of 500 to 600 ft.; the little Karoo (Regions 9 and 10) at about 1,500 ft.; the great Karoo (Regions 9 and 11) at 2,000 to 3,000 ft.; and finally, the High Veld comprising the greater part of the country at an average elevation of 4,000 to 5,000 ft. Such relatively high elevations—40% of the country lies at over 4,000 ft.—has led to deep river valleys with steep gradients and no wide alluvial flats conveniently situated for irrigation such as we find in many irrigating countries.

The coastal regions, too, vary greatly in width and character, ranging from the arid conditions of Namaqualand in the west (Region 6) to the sub-tropical conditions of Zululand in the east (Region 21). Although the coastal plain is at its widest here and easier physical conditions prevail for a large irrigation scheme east of the Lebombo Mountains, the climate is severe in summer and the mosquito and tsetse fly, plaguing man and beast, require eradicating before large-scale irrigation development is feasible.



MAP OF THE UNION OF SOUTH AFRICA SHOWING DRAINAGE REGIONS.

Rainfall

The type of precipitation in the Union which largely determines the irrigation water requirements of crops is mostly (86%) of the summer rainfall type occurring between November and March. It is only in the south-western districts (Regions 5, 7 and 8) that we find a winter rainfall type, with the remainder of the country (4%) mostly in the coastal regions, 10, 12, 14 and 16, enjoying a rainfall more or less distributed throughout the year. The mean annual rainfall in the Union is only about 17½ in., while three-quarters of the country has an average of less than 25 in. The wettest zones with over 70 in. per annum are to be found in the moun-

tainous districts of the Berg River Hoek and Wemmer's Hoek near Cape Town, the Drakensberg Range in Natal, the Zoutpansberg in the north, and the Drakensberg in the north-east of Transvaal. The driest parts of the country, on the other hand, are to be found in the desert-like conditions at the mouth of the Orange River, and large portions of this river basin have less than 5 in. of rainfall per annum.

Water laws

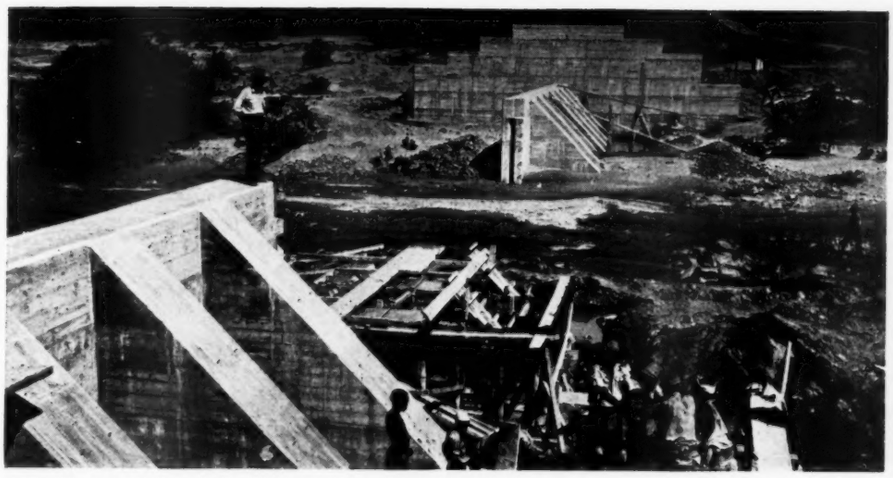
Reference should be made to the water laws of the country in view of their importance and effect on irrigation. Briefly, the right to use the water of a public stream in the Union belongs to the owner of the land bounded or traversed by such a stream, and each riparian owner is entitled to a proportionate share of the water for irrigation. It will be seen, therefore, that there is no public ownership of water in South Africa, and that the right to use it is not granted by the State, as in some other irrigating countries.

The use of a public stream is made subject also to primary (domestic), secondary (irrigation) and tertiary (industrial) requirements. The basic Act controlling irrigation in the Union (No. 8 of 1912), with its subsequent amendments, classifies public and private streams and provides, briefly, for the building of irrigation works, control of the schemes for which such works are built, the rights to water, and the exercise of these rights for the purpose of irrigating land. At present, a commission, under the chairmanship of a Judge of the Supreme Court, is reviewing the water laws of the Union.

State aid for irrigation

The principle of State aid for irrigation goes back to 1877 when an Act was passed in the Cape Colony establishing irrigation districts and granting boards the use of State funds as loans. In 1903, both the Cape Colony and the Transvaal formed special departments to control irrigation; and the principle of State aid was extended to the whole country with the passing of the Irrigation Act by the Union Parliament in 1912. A notable feature of irrigation in the Union is the large part played by the initiative and enterprise of the private farmer, and this is fostered by the State providing the services of Government irrigation engineers, at a nominal fee, to investigate and design suitable irrigation structures on farms.

In addition, subsidies and loans are paid to private farmers who build approved works, and to associations of riparian owners who form irrigation or river districts and elect their own control boards in terms of the Act. The earlier board schemes were not subsidised, and the landowners concerned were expected to repay the full capital cost and interest, but, as in other irrigating countries, it was found eventually that high capital costs and the indirect benefits received by the State from irrigation works justified subsidies if progress was to be maintained. This change in policy resulted in large capital sums and accrued interest being written off under the authority of Parliament.



In the rainy season, the Vlekpoort, Hoffmeyr, is a raging torrent 100 yards wide. Hence the weir, which the irrigation department is building as part of the vast governmental scheme to reclaim the worst soil-eroded area in South Africa

Main drainage regions

A study of the drainage region map shows that the rivers of the Union can be classified into three main groups: rivers draining the interior plateau like the Orange and Limpopo; rivers like the Tugela rising in the escarpment or on the slope to the sea below it; rivers like the Breede rising in the ' Folded Belt ' which is the name given by geologists to the mountain ranges and the wide valleys between them in the south of the Cape Province. All the drainage from the interior plateau eventually reaches the Atlantic and Indian Oceans via the Orange and Limpopo Rivers.

Irrigation development

The total area under irrigation in the Union is just over 1 million acres. It should be explained here that the most commonly used unit of surface measurement in the Union is the *morgen*, which is equivalent to $2^{1}/_{9}$ acres but, for the benefit of readers, acres have been used throughout this article. Similarly, the acre foot has been used as the unit of storage (1 acre ft. equals 271,472 imp. gal., or 325,850 gal. U.S.A., and is equivalent to 1 acre covered to a depth of 1 ft.).

In order to demonstrate the distribution of irrigation and the varying conditions under which it is carried out in the Union, the various drainage regions and their chief irrigation schemes are described below.

Limpopo River region

The Limpopo River, which enters the Indian Ocean about 80 miles north of the city of Lourenco Marques in Mozambique, has, as part of the watershed dividing it from the rivers flowing southwards to the Atlantic Ocean, the gold-bearing ridge known as the ' Witwatersrand.' This ridge, so important to the economy of the Union and the situation of the largest city Johannesburg, extends eastwards from there for about 120 miles where it meets the other main watershed of the Limpopo region, the Drakensberg range forming the eastern escarpment.

Except for its upper reaches, the Limpopo River itself is not used to any great extent for irrigation. A number of tributaries are limited in their irrigation use to small farm schemes. The Olifants drains the high rainfall zone of the eastern escarpment, but the Crocodile basin nowhere enjoys more than a 35 in. rainfall with less than 20 in. where it joins the Limpopo.

Lower rainfall conditions have made storage more or less essential in the Crocodile basin, and the need has been met by building a series of storage dams on headwater streams in the area. Hartebeestpoort is the largest irrigation scheme on the Crocodile River. Here, the first large concrete arch dam in South Africa was completed in 1924.

From the storage dam, canals extend down both river banks for about 40 miles, irrigating about 32,000 acres at an elevation of 3,400 to 3,900 ft. above sea level, where the average rainfall is 23 in. per annum. Irrigation is in progress throughout the year during a winter and summer season. The crops grown include wheat, tobacco, lucerne and vegetables, with a small area under flowers grown for sale in the neighbouring cities of Johannesburg and Pretoria.

Komati River region

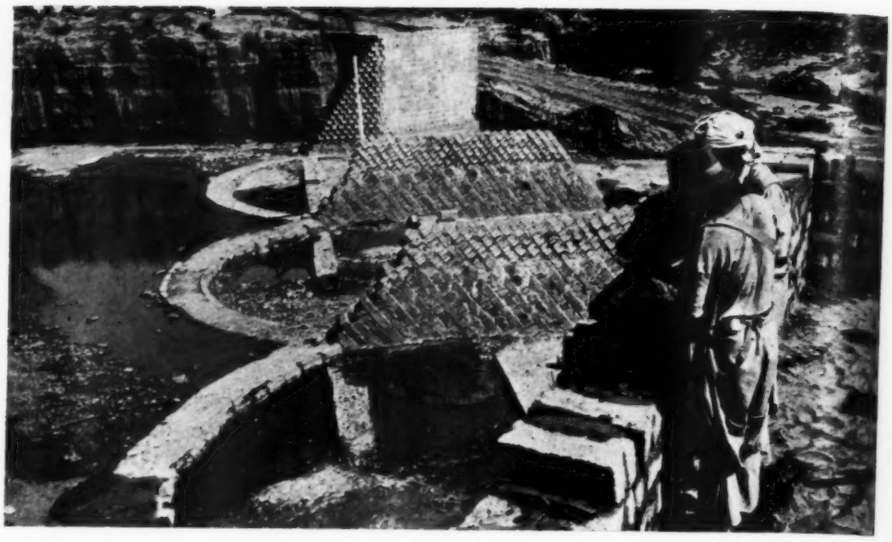
This is a well-watered region with a number of perennial rivers—Komati, Lomati, Crocodile, White, Sabie—rising in the high rainfall zone of the eastern escarpment. Irrigation by diversion and pumping is practised fairly extensively. The irrigation areas lie principally in the Low Veld between an elevation of about 2,000 ft. and 600 ft. Sub-tropical conditions prevail in the Low Veld and features are large private estates with citrus orchards, and the extensive cultivation of winter vegetables, with cotton as an auxiliary crop in the Barberton district.

Vaal River region

From the engineering viewpoint, this is the most highly developed region in the Union, with a number of major structures for the storage and diversion of water. This water is used for irrigation and as a source of domestic and industrial supply.

The major engineering structures are *Vaaldam*, the largest storage dam in the Union with a capacity of 873,000 acre ft., situated about 250 miles below the river source; the *Rand Water Board Barrage*—capacity 50,000 acre ft.—about 45 miles below Vaaldam; and the *Vaal Hartz Irrigation Scheme* intake works about 320 miles below the barrage. The primary function of Vaaldam is to store surplus flood water in summer and from this to keep the barrage full and provide water for the Vaal Hartz irrigation works. In fact, the conditions of a perennial river have been created below Vaaldam by a steady discharge of the order of 800 cu. ft. per sec.

The possibilities of the Vaal Hartz Scheme were visualised over 50 years ago when Cecil Rhodes had an investigation made, but the scale of the project delayed its inception until 1934 when Parliament approved of it at an estimated cost of £3½ million. The construction of the scheme was carried out by the Irrigation Department simultaneously with the Vaaldam. The two features which made the scheme feasible were the presence of good soil suitable for irrigation in the lower Hartz valley, and a low saddle between the river valleys making pumping unnecessary. At present, 52,000 acres are under irrigation at Vaal-Hartz, but eventually the scheme will provide for 90,000 acres divided into 1,200 plots of 40 to 65 acres each, occupied by European settlers, 13,000 acres in a native reserve, and 5,000 acres on private farms. The principal crops are lucerne, wheat, groundnuts and potatoes; the rainfall on the settlement averages 17 in. per annum. The total capital expenditure on the three major engineering works referred to above was of the order of £6 millions.



This type of arch dam (*right*) is playing a big part in soil reclamation. The arch and pillars, made of pre-fabricated brick, and 9 in. thick, take the main strain of water and silt. Another type of arched dam (*above*) at Vlekpoort, Hoffmeyr, has three arches of pre-fabricated brick. Such dams at regular intervals catch silt and, in time, bring dongas and sluits up to the level of surrounding grounds

Orange River region

Although the Orange River is the largest drainage region in the Union, and is fed from the high rainfall zone of the Drakensberg, its run-off is low, and its low-flow practically all comes from the upper 10% of the catchment area. For about 1,200 miles from its source the Orange River flows westward across the country to enter the Atlantic Ocean, being joined by its chief tributary, the Vaal River, after about 500 miles. The rainfall diminishes rapidly in the westwards course of the river, being reduced to below 15 in. at the Vaal confluence, and for the last 200 miles to the river mouth is below 5 in. per annum.

Apart from small farm schemes which are fairly general throughout this region, large-scale irrigation is confined to the vicinity of the Caledon River, a large headwater tributary. The small Egmont Scheme which has been built on a tributary of the Caledon River has a storage dam on the Witte Spruit. A feature of the schemes on the Hartebeest-Sak and Brak-Ongers tributaries is a type of basin irrigation, whereby flood water is impounded in large shallow basins known as Saaidams inside which cereal crops are

A native labourer, employed on a private irrigation scheme near Kimberley, fills in a bank to cut off the water after a field has been flooded

cultivated. Along both banks of the Orange River for a distance of about 150 miles are a series of irrigation schemes starting about 100 miles downstream of the Vaal River confluence. The uppermost was completed in 1934 and consists of a storage weir with undersluices to deal with the large volume of silt. From this a canal irrigates about 8,500 acres. Altogether about 40,000 acres are under irrigation along this stretch of the Orange River. The crops grown in this 5 to 10 in. rainfall belt include lucerne, sultanas and citrus fruit, with a certain amount of cotton.

Olifants River and Western regions

The Olifants River region comprises one complete river system. Rising in the mountains about 10 miles north of the town of Ceres, the Olifants flows northwards in a narrow valley until it opens out near where the river enters the Atlantic Ocean. Irrigation by the diversion of mountain streams has been long practised, but it is only since the construction of engineering works that the lower valley has been able to produce crops regularly.

Started in 1912 as the result of the earlier investigations made by the Irrigation Department of the Cape Colony, the *Olifants River Irrigation Scheme* was the first large-scale project authorised by the Union Government. It included a masonry barrage at Bulshoek with a canal system on both banks. Eventually, more storage became necessary, and a dam was completed in 1935 near Clanwilliam, from which the dam takes its name. This has a capacity of 60,000 acre ft. and stores surplus water in winter for release in the dry summer season when irrigation is essential. The total area under irrigation is about 20,000 acres.

Citrus fruit is produced extensively in this valley, the total area under this crop being nearly 3,000 acres.

South-western region

The south-western region lies entirely in the winter rainfall area and supports the densest population in the Union in the vicinity of Cape Town. The average rainfall is about 35 in. per annum, but in the mountains behind Cape Town it exceeds 100 in. per annum in places. The Great Berg is the principal river. It has three co-sources in the high rainfall zone, but in its 150-mile course to the ocean it passes through diminishing rainfall which is reduced finally to 10 in. near the river mouth.

Much of the 10 to 20 in. rainfall belt is given over to wheat growing. The largest wheat-producing area in the Union centres round the towns of Malmesbury and Moreesburg, where wheat is grown without irrigation. Farmers in Stellenbosch and Paarl, chiefly concerned with wine and fruit growing, irrigate extensively, but there are no large-scale irrigation works in this region so far, largely because of the favourable climatic conditions. An interesting development now in progress, however, is the utilisation of a natural depression, Vogel Vlei, to store surplus water in winter from the Little Berg River. The works now under construction include a 6-mile concrete lined inlet canal carrying 300 cu. ft. per sec., as well as outlet works to the Great Berg River.

By contrast, the Breede River region is the most intensively irrigated region in the whole Union; the average annual rainfall in the irrigated area is about 12½ in., and irrigation of the fertile valley lands is required during most months of the year. So far, large-scale storage works are confined to Brandvlei Dam situated near the town of Worcester, where the storage capacity has just been raised to 72,000 acre ft.

Gouritz and Gamtoos River regions

The upper portions of both these regions drain large areas of the low-rainfall Karroo, and the rivers have an erratic run-off and a heavy silt charge when in flood. As a result, irrigators have become skilled at diverting freshets on to their lands by ' flood furrows,' designed to irrigate as big an area as possible while the flow lasts.

Two small storage dams have been built on tributaries of the Gamka River and lower down are two more small dams. Gamkapoort on two important tributaries joins the Gouritz in the last 60 miles of its course. Three small storage dams have been built on tributaries of the Groot River. These are amongst the most expensive in the Union and are handicapped by the loss of capacity due to silt and high evaporation losses.

The town of Oudtshoorn, in the heart of the irrigated area, has an annual rainfall of about 9½ in. and the crops grown under irrigation include tobacco, lucerne and vine yards (table grapes and sultanas). The original capital cost of the Kamanassie scheme was about £3¼ millions.

Sundays and Great Fish River regions

A feature in these regions is the enterprise of farmers and land-owning companies in constructing diversion works and flood furrows. In fact, this development had reached the stage that storage works had become essential just about the outbreak of World War I; by 1926 two dams had been built in each region.

The two schemes on the Sundays River are quite distinct. The upper one is located near the town of Graaff Reinet, and the lower 110 miles further downstream. Both dams are of concrete gravity section type; the irrigable area extends about 40 miles down the valley and covers 8,000 acres. The annual rainfall at Graaff Reinet is 14 in. and the principal crop under irrigation is lucerne.

The Great Fish River region has no less than 12 irrigation districts with about 42,000 acres under irrigation. The two storage dams are at Grassridge, the Great Brak River and at Lake Arthur on the

Tarka River. Both dams have had to be raised since their construction due to silt deposits.

Outeniqua, Algoa Bay and Great Bushmans River regions

All three of these regions have comparatively short rivers and there are no major irrigation schemes at present. The Outeniqua region has a rainfall evenly distributed throughout the year so that irrigation is not so essential, but the Great Bushmans River region is in a much dryer belt where irrigation is likely to develop.

Amatola, Great Kei River and Transkei regions

The Amatola region is comparatively small and its principal rivers have their origin in a high rainfall zone on the Pirie range. An earthen dam is under construction on the Upper Buffalo River. This is to serve a new textile factory, for irrigation in the valley below the dam, and the domestic supply of Kingwilliamstown. So far no irrigation districts have been formed in the Great Kei River region, but a number of small irrigation schemes have been built for the benefit of the native population, and irrigation is also practised on many European-owned farms by diversion or pumping.

The Transkei region has a number of large independent river systems. Most of this region is within the large native reserve known as the United Transkeion Territories which covers a total area of 16,000 square miles. With a summer type rainfall, ranging from 25 in. in the valleys up to over 50 in. per annum on the Drakensburg watershed, the Transkei is one of the best watered regions in the Union with a high run-off rate presenting almost unlimited possibilities for small irrigation schemes from its perennial streams. So far, however, the area under irrigation is small, but this area can be greatly expanded.

Natal, Tugela River and Zululand regions

All three of these regions are well watered. In the Natal region, perennial rivers supply water to sugar mills for industrial purposes. Sugar cultivation under irrigation is confined at present to the Illovo Umgeni and Umvoti Rivers with about 15,000 acres under this crop on private sugar estates.

As only about 26% of the region has a rainfall as low as 30 in. per annum, irrigation is limited. The bountiful water resources make it inevitable, however, that its greater use by agriculture and industry will ensue as soon as the river flow is stabilised by the necessary balancing dams; the Zululand region also has a number of good rivers, and two irrigation districts have been established with about 4,000 acres under diversion schemes. The major irrigation scheme was completed on the Pongola River in 1934, as a Government settlement of 12,000 acres which will probably be extended in the near future.

Future irrigation development

Considerable investigations have already been carried out and are continuously in progress for new projects to further the development of irrigation in South Africa. So far as Government works are concerned, the future emphasis must be largely on multi-purpose storage dams for the control of streams which cannot support further development unless their low water flow can be strengthened. In pursuit of this policy, the construction of six new dams in different parts of the country is being started.

The possibilities of the largest projects should be mentioned. The first, known as the Orange Great Fish River Project, aims at utilising surplus water from the Orange River in the valleys of the Great Fish and Sundays Rivers (Regions 15 and 13) and is the outcome of considerable investigation into the question of utilising the waters of the Orange River to the best advantage.

Unfortunately, this steeply graded silty river has no areas suitable for irrigation as a major scheme of, say, 100,000 acres, and there is more than sufficient water, with storage, to satisfy all the smaller schemes which are considered feasible. In consequence, a project is being examined to divert about a million acre ft. per annum from the Orange River into the Great Fish and Sundays River valleys, where it is estimated that a total of about 200,000 acres of suitable soil, including the existing schemes, could be irrigated. The engineering works involved are considerable.

The other major project is in Zululand (Region 21) on the Pongola River where a storage dam in the Lebombo mountains gorge would permit the irrigation of about 170,000 acres of the coastal flats below. This is known as the Makitini Flats Project, and a rough estimate puts the cost at about £13 million.

Two smaller projects in the Vaal River region (No. 3) are the Sand-Vet Project and the raising of Vaaldam to meet greater demands.

Current expenditure

The scale of present-day operations for the conservation and utilisation of water is indicated by the expenditure authorised by Parliament on the Irrigation Vote during the financial year 1949-50 which totalled nearly £4 million, of which nearly half was spent on the construction of new or the extension of existing irrigation works. The balance of the expenditure was spent on the betterment of existing irrigation schemes, on developing underground water supplies by boring, and on the payment of subsidies to local bodies for the development of irrigation or domestic water supplies to towns and villages.

Israeli Farming Notes

As a result of the late rains throughout the country the outlook for summer crops is reported to be excellent, even though the rains have been able to counteract only to a limited extent the damage caused to winter crops. Farmers were nevertheless urged to complete their spring planting, especially of potatoes, without delay, in order that maximum advantage might be taken of the March rains.

Special efforts are being made this year to increase the summer crops of cattle fodder. Special seminars on this question have been held for settlements, and a competition has been arranged in which prizes will be given to those settlements with the best yields. It is hoped that 160,000 dunams of sorghum will be sown this year, and that a similar area will be put under unirrigated maize. These crops have sometimes produced exceptionally high yields in the past, often greater in quantity than the winter ones.

In order to offset the failure of the barley crop in the Negev this year, special efforts to produce a large sunflower seed crop are being made by the Ministry of Agriculture; it is expected that 15,000 irrigated dunams will be put under this crop.

A total of 200,000 man-days are to be allocated this summer to the programme of preparing 115,000 dunams for natural grazing land. The land, which is situated in various parts of the country, is not suitable for cultivation; but by sowing wild grass, planting carob trees, and preparing pools for drinking water, the Ministry intends to turn this land into useful meadows.

Some $4\frac{1}{2}$ million saplings were prepared by the Forestry Department during the winter. Of these, 2 million were planted by the Department in various parts of the country, another 2 million were distributed gratis to all who applied for them, while the remaining $\frac{1}{2}$ million were kept in tree nurseries for an additional year for eventual planting in parks and avenues. The work of preparing saplings, planting trees, and thinning forests provided 250,000 man-days for new immigrants.

The Potentialities of Rubber as a Raw Material for Agricultural Machinery Construction

PART II

J. M. BESKINE, B.Sc., A.M.I.B.A.E.

In Part I of this article, the application of rubber to agriculture was discussed and the properties of rubber surveyed. In this instalment, a number of important technical aspects of rubber and of rubber component design are discussed.

RUBBER can be hard and board-like; it can also be soft and spongy. By adding 20% of reinforcing carbon black the stiffness increases considerably. By increasing the sulphur content a harder material is obtained, and ultimately with a maximum sulphur content (about 30%) a true hard rubber or ebonite* is obtained with distinct properties of its own, many of them quite different from what we call 'rubber.' Rubbers, other than ebonite, have a remarkable capacity for absorbing and storing strain energy. Furthermore, these materials can be stressed in any direction, unlike a spring which can only be stressed in one direction. It is these characteristics, together with high abrasion resistance, which render rubber products so valuable for agricultural machine construction and operation.

But rubber possesses certain disadvantages too. These are as follows:—

(*a*) 'Ageing'† due to exposure to strong, prolonged sunlight. ' Ageing ' causes deterioration of elastic properties and leads to ' perishing.'

(*b*) Swelling due to the action of oils, petrol, etc.; also absorption of fats from animal products such as milk.

(*c*) The small temperature range over which rubber can be employed, compared with metals and wood. Compounding is employed to reduce these disadvantages and for this reason the component designer must be very specific regarding the duty to be imposed upon rubber components. If full information is passed on to the manufacturer, it is possible to select the best formulation or material for a given purpose. Satisfactory rubber components can be produced only if there is close co-operation between designer and the rubber manufacturer.

Effect of reinforcing agents

When reinforcing agents are employed in rubber manufacture, there are five possible consequences according to the agent employed:

(*a*) The stiffness and nominal breaking stress is improved.

(*b*) The elongation when breaking point is reached is lessened.

(*c*) The resilience is *reduced.*

Rubber boots worn by sheep were experimented with some years ago in an attempt to combat the spread of disease

(*d*) The permanent set is slightly increased.

(*e*) Resistance to abrasion is improved.

This means that by reinforcement with the aid of suitable additives, a given rubber with a given percentage of sulphur will become ' stronger,' inasmuch as it will not break unless a greater load is imposed. It also means that the material and the component is stiffer, *i.e.* it will be less easily deformed. Resilience is a measure of the ability of a material to absorb strain energy, to absorb shocks, and this property is reduced when producing a ' stronger ' rubber. A good point is, of course, the increased abrasion resistance which follows from reinforcement. This gives us the two main agricultural uses for rubber: tyres, transmission belts, conveyor belts, crawler tractor track pads, etc. at one extreme; and shock absorbers, bumpers, flexing joints between the links of certain makes of crawler tractor tracks, etc. at the other extreme. This is a rough and ready division, but it indicates the scope of rubber as an agricultural material. There are other uses for rubber in agriculture, but where these do not call for great strength, wear or abrasion resistance, or flexibility and fatigue resistance, it can be taken for granted that no difficulty is found in selecting suitable formulations since severe conditions are not being encountered. Of course, for very special purposes such as the bulk handling of fertilisers, it may be necessary to provide maximum chemical resistance and maximum strength, etc. The use of rubberised metal mesh and so on is another approach to this and similar problems and will be discussed subsequently.

Stiffness and resilience in practice depend on the frequency of applied stress and the greatest variations occur near the freezing and melting temperatures. This is of major importance in equipment for hot or cold climates, etc. If the frequency of stress is increased, the effect is similar to a reduction of temperature:

*Hard rubber or ebonite or vulcanite is employed for mouldings and similar purposes. In general, it is applicable where these properties are of value: mouldability, high tensile strength, high compressive strength, high shear strength, ability to carry a high gloss, machinability, low thermal conductivity, high electrolytic resistance, resistance to acids, alkalies and other chemicals and low water absorbtion.

A wide range of hard rubbers is also available which, while approaching ebonite, are not as hard.

† Ageing causes two conflicting sets of processes to occur. One leads to a strengthening of the rubber structure; the other leads to a softening and breakdown of the structure. The balance depends upon the rubber itself; it also depends upon the presence of ageing factors and age resistors. Ageing factors include oxygen, ozone, oil, stress, fatigue, heat, etc., and if many of these factors are present simultaneously, the ageing effect may be accentuated. Age resistors are organic compounds employed to offset ageing. No rubber is completely and permanently age-stable. For practical purposes, however, if correctly selected, applied and employed, rubber should have as long a life as most non-structural engineering components, especially those which are subjected to vibration and wear. These considerations help to clarify the inter-relations between performance, nature of material and service conditions faced.

it leads to a reduction in resilience, lessened flexibility, increased hardness and eventually brittleness. Rubber has no definite freezing or melting points, but has a melting range — a temperature band over which its mechanical properties change, at first gradually and then abruptly. *It has been suggested that a barrier temperature exists*, below which rubber will not warm up no matter how it is worked, *i.e.* however, it is subjected to intermittent stress cycles. The importance of this concept with regard to engine mountings should be obvious. It is of equal importance in all branches of agricultural engineering and reminds one of the need for designing equipment so as to enable all rubber components under stress to be cooled, especially in the vicinity of engines and where high atmospheric temperatures are at all likely. If these points are taken care of, stressed rubber components should have a much longer life than they so often do.

TABLE I

MECHANICAL PROPERTIES OF TYPICAL INDUSTRIAL RUBBERS AND ARTIFICIAL RUBBERS

Materials	*Natural rubber compounds*		*Artificial rubbers*	
	(1)	(2)	(3)	(4)
Tensile strength (lb. per sq. in.)	4,400	4,400	3,200	4,100
Elongation at break (%)	600	600	600	580
Tear strength (lb. per sq. in.)	2,600	2,600	850	1,400
Hardness (Shore 'A')	60	60	60	60
Maximum service temperature (°F)	212	257	212	212
Energy at break (in.-lb. per sq. in.)	4,200	4,200	2,200	2,800
Swelling in petrol (Vol. %)	250	280	250	250

Details of compounds compared: Natural rubbers (1) technical carbon black compounds 25% (vol.), carbon black; (2) heat-resisting compounds 25% (vol.), carbon black. Artificial rubbers: (3) GR-S, standard, 30% (vol.), carbon black; (4) GR-S, cold rubber, 25% (vol.), carbon black.

Vulcanised rubber made from latex

Competition between artificial rubber and natural rubber may yet prove to be a blessing in disguise. So far (see Table I) artificial rubber has not yet been able to equal natural rubber in its elastic properties, abrasion resistance and resilience.*

It should not be taken for granted that artificial rubber will necessarily be cheaper than natural rubber; it depends to a large extent upon the cost of producing petroleum and its transportation cost, etc. The use of coal and agricultural products for rubber production would normally be, in the author's view, wasteful except under emergency conditions.

A cow-stall with rubber flooring

Shipping rubber as liquid latex is associated with an important technical advantage which is not always fully realised; vulcanised rubber made from latex is superior to that made from smoked sheet and crepe.

The tensile strength of vulcanised rubber obtained from latex is higher than that of vulcanised rubber from natural rubber, crepe or smoked sheet. Latex-based products have a better elongation and are stronger than, not only corresponding processed rubber compounds, but also reinforced rubbers. For example, the strongest vulcanised rubber compounded with lamp black rarely gives a product whose tensile strength reaches 5,000 lb. per sq. in., but various research workers have published details of latex mixes and vulcanising processes which yield materials having tensile strengths as high as 5,970 lb. per sq. in., and even 6,300 lb. per sq. in. The conclusion which should be drawn is that a great improvement in the performance of natural rubber products is possible.

A rubber-lined fruit picking pail to prevent bruising of delicate fruit during picking

Heat resisting properties

When selecting a rubber for high temperature service, it is essential to bear in mind the basic properties of rubber, the improvements which are possible, and the requirements of the job. The manufacturer should ensure that unnecessarily high temperatures are not imposed, as, for example, by failing to ensure that adequate cooling takes place. If short-period heating or over-heating may occur, the nature of the cooling facilities should be stated. If they are not sufficient, it may pay to consider so designing the equipment as to enable proper cooling of rubber components to take place.

Generally, it is not recommended that rubber be used if the maximum short-period temperature is likely to exceed 200° F., although where the mechanical requirements are not severe it may be

*Resilience can be regarded as a measure of the elastic energy stored within a material. It can be expressed as a percentage and the difference between this figure and 100% is a measure of the energy dissipated as heat by hysteresis when the material is deformed. The superiority of natural rubber over artificial rubbers is indicated by the following figures for percentage resilience: Natural rubber, 90%; neoprene (GN), 75%; thickol (A), 57%; neoprene (1), 55%; butyl, 50%.

possible to employ rubber at short-period temperatures of up to 300° F. In any case, it should be remembered that it is not only the temperature which counts but the period of time for which a high temperature is maintained.

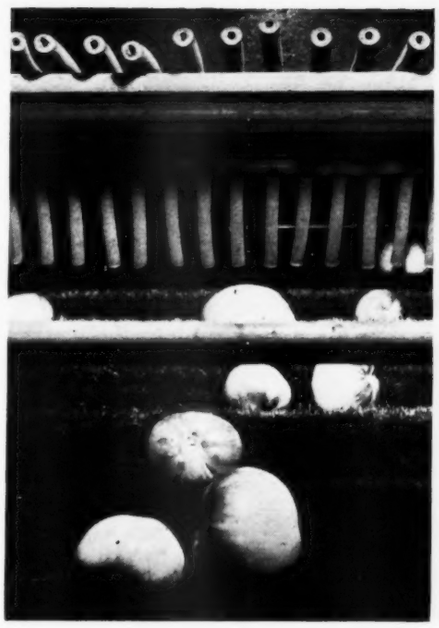
As far as continuous heating is concerned, for 'ordinary' industrial rubbers a temperature of 140° F. should not be exceeded (60° C.), especially if the rubber is under load, as permanent set may occur.

At low temperatures, below —10° C., rubber loses its resilience and becomes stiff and hard; it becomes opaque and is in the so-called frozen state. At very low temperatures it becomes brittle. The actual working temperature range, of course, depends upon the formulation and processing employed and the natural rubber used in the first instance.

Fatigue as a limiting factor

Fatigue is an important consideration when designing rubber components. There are two types of fatigue, static and dynamic. In either case, a rubber component may fail or become inefficient in performance. Also, if a dead load somewhat less than the breaking load is applied for a long period a rubber component may fail, and ageing will accentuate this process. A heavily overloaded component designed to produce maximum strength may suffer considerable permanent deformation if the overload is applied for a long time. For this reason, rubber components should have a good factor of safety; they should be more robust than appears to be necessary from a study of elasticity formulae and stress-strain curves.

In this case, static loads are referred to, but the same argument applies to dynamic loads.



A fruit grader showing rubber anti-bruising handling facilities

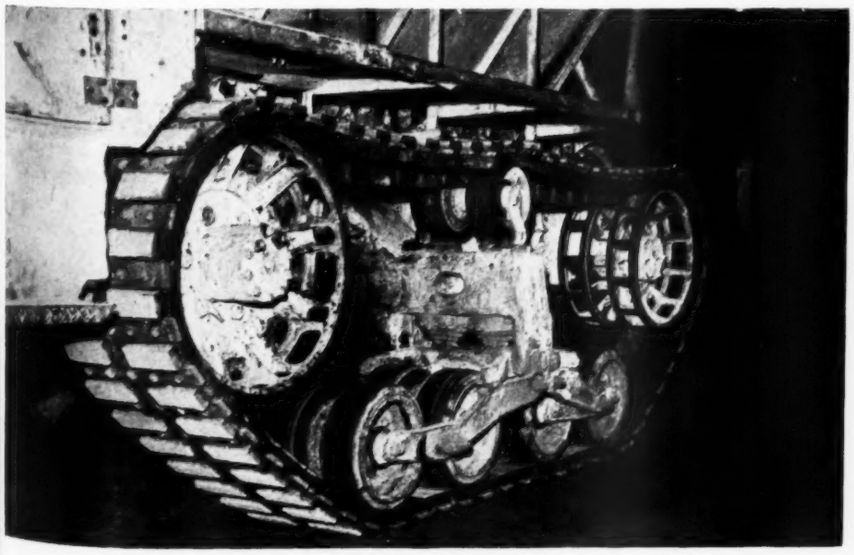
Dynamic fatigue is brought about by progressive loss of strength due to repeated stress cycles. When subjected to repeated stress cycles, rapidly reversing loads, shock, etc., and due to high atmospheric temperatures, near presence of hot engines, etc., the rubber may fail by overheating since its temperature rises every time it is subjected to a stress cycle. For this reason, it is essential that rubber components subjected to heavy and rapid shock loads are kept cool. In agricultural machinery, this implies locating the engine so as to avoid heating rubber components, etc. Fatigue in rubber is a much more complex phenomenon than fatigue in metals and it is essential to work to a maximum temperature and to a known range of stress and stress cycles per minute, etc., when designing rubber components which will have to withstand dynamic fatigue.

So far, little numerical data has been given for the properties of different industrial rubbers. The real difficulty is that there is no standardisation of rubber compounds and formulations although the British Standards Institute has issued comprehensive specifications for transmission and conveyor belts, pressure hose, etc. These unfortunately do not help one to select a rubber for a given purpose as one would select steel or a timber. If rubber compounds were standardised, it would be a more simple matter to select a suitable rubber for a given purpose. As it is, one must be very careful indeed when attempting to interpret rubber performance data.

Designing rubber components for agriculture

Broadly speaking, there are two main divisions of rubber application in agriculture. These are (*a*) where shock absorbtion is the first consideration, and (*b*) where insulation from continuous vibration is more important. At first sight one might think of numerous applications which do not appear to come within either of these categories; but consideration will show that generally speaking these applications are such that rubber is only one of a number of materials which might be employed. For example, rubber as a water-proofing agent or as a solid moulding, or as a mat, etc., is competing with other materials, *e.g.* plastics, fabrics, die castings, etc. The main advantage of making greater use of rubber in agriculture is that for many purposes it cannot be equalled or bettered by other materials.

For (*a*) shock absorbing, the requirements are a high energy absorbtion and a *low* resilience. For (*b*) insulation from vibration, the need of flexibility and *high* resilience.* These applications make use of different physical properties and different industrial rubbers must be selected. In some cases, a rubber part must function sometimes as a shock absorber and some-



A steel-reinforced rubber-bonded crawler track

* An important example of flexibility and of complex design is hydraulic control hose for power-lift-equipped tractors and bulldozers. This must resist great internal pressure as well as attack by oil. Another example is pressure-greasing hose which must resist grease and a considerable pressure difference between inlet and outlet. Such hose consists of multi-layered rubber, fabric, wire-braid, etc.

times as a vibration insulator, and sometimes as both at once, and here a compromise is required and the most important function is favoured in selecting the material and designing the component.

Actually there are four stages in the design of a rubber load-bearing component, *viz.* (*a*) definition of requirements; (*b*) design of the component; (*c*) selection of the rubber to be used; and (*d*) designing the rubber compound to be employed. Close liaison between the farmer, horticulturist, experimental engineer and manufacturer is required for stage (*a*); stage (*b*) (see Table 2) calls for both mechanical and rubber engineering knowledge; and stage (*c*) can only be carried out after the manufacturing and agricultural experts have reached agreement. The final stage, of course, must be left to the rubber manufacturer.

TABLE 2

PRELIMINARY FACTORS WHICH MUST BE CONSIDERED WHEN SERVICE CONDITIONS ARE BEING LISTED PRIOR TO SELECTION OF AN INDUSTRIAL RUBBER AND DESIGN OF A RUBBER COMPONENT FOR AGRICULTURAL PURPOSES

Chemical Considerations

Will the following be handled or be present ?
- Corrosive gases.
- Oil, petrol, grease.
- Other solvents.
- Acids.
- Alkalies.
- Farmyard manure.
- Artificial fertilisers.

Mechanical Considerations

Type of load to be resisted . . .
Stress:
- Tensile ?
- Compressive ?
- Shear ?
- Torsion ?
- Combined ?

Is loading static, continuous, transient, irregular, regular, etc. ?
Is deformation continuous or transient ?
Design limitations on deformation, if any.

Temperature Considerations

Average working temperature.
Maximum temperature range.
Details of cooling facilities and difficulties.

The use of rubber in shear

Rubber components may be made to resist intermittent loads by applying them so as to impose compression, shear or torsion on the material. Tradition favours using rubber in compression, but for many purposes superior results may be obtained by using it in shear. Torsion is a form of shear, but there are other methods of resisting torsional oscillations, *e.g.* friction discs, steel torsion bars, etc., and the present discussion is confined to shear.

The advantages of employing rubber in compression are nevertheless numerous; rubber so stressed has a higher energy-storing capacity; it is not difficult to manufacture the components or to apply them. On the other hand, there are disadvantages, *e.g.* large and sometimes awkward shapes are often required; the design of the component is based on empirical data and considerable trial and error may be necessary; also the stress-strain curve is not linear, which complicates attempts at forecasting performance.

The best way of employing the unique properties of rubber is undoubtedly to design components which oppose intermittent loads to the shear resistance of the rubber. The natural flexibility is thus made fuller use of; the stress-strain curve for rubber in shear is nearly straight up to the maximum stresses generally employed. The main problems are associated with lack of experience in designing shear-stressed rubber components and lack of data and constants based on past applications and on accepted theory of stressing and design.

Another difficulty is that shear-stressed rubber parts must be firmly anchored, which implies in practice, rubber bonding to metal. Many specialist rubber bonding factories are in existence and in addition to a very wide range of standard components, specially designed components can be manufactured to suit practically any problem (see Table 3).

TABLE 3

TYPICAL APPLICATIONS OF RUBBER-BONDED UNITS

Compression mountings and buffers.
Concentric tube mountings.
Tension mountings and links.
Shear mountings and links.
Pipe connections.
Shaft couplings.
Bearings and bushes (rubber bearings).
Solid tyres, friction rings, oilers.
Piston and valve parts.
Rubber-faced discs.
Covers, strips, inserts.
Seals.
Electrical insulators.
Non-metallic adhesions to carbon, glass, plastics, etc.

There are three main general applications for rubber-bonded units, thus:
- (*a*) Insulation of sound and resistance to vibrations.
- (*b*) Resistance to wear, tear and corrosion; also for friction-producing purposes, *e.g.* brakes, dampers, etc.
- (*c*) For sealing fluids, exclusion of dust and gas, an unusual example being the use of a rubber gas-proof zip fastener.

Finally, it should be remembered that rubber components could be designed to carry both compressive loads and shear loads.

An important example is in aircraft construction where shear-loaded rubber components carry vibrating loads and also carry compression loads due to gravity, acceleration and lift, etc. In such a case, a rubber component may be 50 times as stiff in compression as in shear. In this connection, it is worth recalling that modern agricultural tractor tyres were made possible, very largely, because of the development of low pressure tyres for aircraft.

TABLE 4

RANDOM EXAMPLES OF ADVANTAGES ASSOCIATED WITH THE USE OF RUBBER IN AGRICULTURE

Application	*Advantages claimed*
Moulded rubber rotating flails for 'Rota-Beater' crop shredder	Superior to chains, wire and belting for flailing action.
Rubberised binder canvases and combined harvester canvases.	Superior to unrubberised canvases because of ability to resist moisture (which may strain and tear canvas), especially when dealing with green crops.
Rubberised vee-belts, transmission belts.	Superior to pintle and roller chains when working in dusty conditions; good flexibility and ease of adjustment.
Milking machine teat cup liners, air lines and milk lines.	Ability to withstand repeated steam sterilisation (if properly cleaned of milk).
Rubber mats for the cow house.	Ability to prevent cows from grazing their knees due to softness; also long life (17 years plus).
Rubber horse shoes.	Long life; cheap fitting; speedy application.
Sponge or latex foam pads for egg boxes for transport.	Reduced breakages of eggs in transit.
Reinforced rubber seed ducts for grain drills.	Longer life than steel; quicker recovery after kinking.
Rubber delivery tubes for combined seed and fertiliser drills.	Ability to resist corrosive action of manure, etc.
Protective rubber components for tomato fruit-grading machines (grading vanes, tray and delivery duct linings).	Ability to prevent bruising fruit and tomatoes.

The references for this article appeared in Part I on page 202 of the May issue.

Leverhulme Memorial Lecture

The fourth Leverhulme lecture of the Society of Chemical Industry was delivered at the University, Liverpool, on Wednesday, April 21, by Sir Harold Tempany, who chose, for his subject, the 'Tropics as Sources of Vegetable Oils.'

He passed in review the sources of vegetable oils and concluded that in the future the world would look in an increasing degree to the tropics as sources of vegetable oils, and particularly to the tree crops coconuts and oil palms, which he showed gave much larger returns per unit area than other oil seed crop plants.

Picking Sea Island cotton, West Indies

The Influence of Introduced Crops on Colonial Economies

SIR HAROLD TEMPANY, C.M.G., C.B.E., D.Sc., F.R.I.C.

The development of agriculture in the tropics has been marked by the steady expansion of the production of export crops. Sugar, tea, coffee, cocoa, rubber, fibres of various kinds—to name but a few commodities—have become the principal mainstays of many tropical countries. It is but natural that the cultivation of these export crops should have exerted a marked influence on the economies of the countries in which they are grown, and the way in which these effects have manifested themselves is discussed below.

THE economies of colonial territories, both British and otherwise, are based upon agriculture and particularly on the growth of export crops. Particular crops are associated with different regions—*e.g.* sugar with the West Indies, Mauritius and Fiji; cotton and coffee with Uganda and other East African territories; cocoa with the Gold Coast and Nigeria; rubber with Malaya; cloves with Zanzibar, and so forth. It is hardly surprising that in the circumstances the economic life of territories should have become tied up with the export products grown there. They have in fact profoundly influenced the mode of life of the inhabitants and the character of the populations; they have underlain government policies and have occasioned much legislation. In some cases they have given rise to international arrangements to safeguard producers.

Historical background

Modern colonial development is of comparatively recent growth. The earliest efforts at colonisation by European powers date back only some 450 years, while the majority are much more recent.

Colonisation naturally led to agricultural development; indeed, the growing demand in the temperate countries of the north and west for tropical products was a leading motive in most colonial ventures. From the outset the production of cash crops for export became a predominant consideration. The effect was to give a twist to agricultural development which tended to become concentrated, more often than not, on one single product; food growing for local consumption being regarded as of secondary importance.

Classification of colonial territories

Colonial territories can be classified as follows: (*a*) Those which were originally empty or effectively so, such as the West Indies and Mauritius; (*b*) those which had a previously existing indigenous population practising primitive subsistence agriculture, such as most of the African territories, Malaya, Borneo and Fiji; and (*c*) those with a long history of previous occupation and development, such as Cyprus, Malta and Ceylon (until recently a British colonial dependency and now a dominion), as well as the French North African dependencies and Java, formerly a Dutch dependency.

The development of export crop production normally took two forms—(*a*) the establishment of plantations operated and financed by introduced capital, and (*b*) the encouragement of indigenous populations to grow export crops in addition to their own subsistence agriculture. In some cases, both forms of development occurred side by side, although peasant cultivation usually followed plantation development. This is seen, for example, in rubber cultivation in Malaya and Ceylon, sugar cultivation in the West Indies and Mauritius, or coffee and tobacco cultivation in parts of Africa.

Effect of cash crops on population

At the outset, plantation development was almost exclusively followed. In British dependencies where there was no previously existing indigenous population, or where it was numerically insufficient or otherwise unsuitable to provide plantation labour, recourse was had to large-scale importations from other places, first as slave labour and afterwards as contract labourers. As a result, populations of diverse origins grew up. For example, in many West Indian colonies the population

consists of descendants of Africans originally imported as slaves and of East Indians descended from imported contract labour; in Malaya, it consists of indigenous Malays, of immigrant Chinese and of imported Indian labourers and their descendants; similarly, in Fiji it consists of native Fijians and the descendants of imported Indian labour. In Ceylon, it consists of indigenous Ceylonese plus a considerable admixture of the descendants of imported South Indian labour. In Natal, there is a considerable population of Indians descended from labourers imported to work sugar plantations in addition to indigenous Africans. Usually immigrant populations have preserved their identity and there has been little racial mixture; in consequence in these places export crop production has led to racial diversity and resulting racial problems.

In other parts of Africa, as well as in Indonesia under Dutch rule, reliance was placed throughout mainly on indigenous labour for agricultural development, and although, especially in East Africa, there has been considerable immigration, racial problems are on the whole appreciably less acute.

Effect on food supplies

Where plantation agriculture worked by imported labour predominated, the effect has been for economies mainly dependent on imported food to grow up; plantations depending on the cultivation of one or two export staples naturally tended to rely on imported food paid for by exports rather than to produce it themselves. This has occurred in the West Indies, Mauritius, Malaya and Ceylon; it has not occurred to anything like the same extent in Africa. For example, before the last war food imports into the West Indies averaged over £2 per head of population, and into Malaya £3 per head; in the British African Colonial Dependencies, by contrast, they averaged 2s. per head.

It is noteworthy that wherever self-sufficient native food production once existed, it has been maintained; thus in Malaya, the Malay population continued to produce sufficient rice for its own needs, but not for immigrant labour or urban population. The growth of urban populations largely concerned with handling export produce has been another consequence of the development of export production. It is, however, noteworthy that in a few cases food crop production by immigrants has developed on some scale; an outstanding example is rice cultivation in British and Dutch Guiana.

Excessive dependence on imported foodstuffs is a notable consequence of export production in British Dependencies; its dangers were amply demonstrated in the war years, especially in the 1939-45 world conflict. It was also clearly shown in the depression of the early 1930s, when prices for export commodities slumped considerably more than did those for imported food—*e.g.* rice.

An armful of groundnuts being carried to the windrow after hand digging

The danger had long been appreciated in some non-British territories, such as the former Dutch East Indies, which placed food production in the forefront of policy, as did the Philippines. It began to be appreciated in some British dependencies in the 1930s—*e.g.* Malaya, where, as the result of the recommendations of the 1931 Rice Committee, considerable efforts were inaugurated to step up rice production.

It was this which impelled the Hot Springs Conference on Food Agriculture in 1944, out of which arose the Food and Agriculture Organisation of the United Nations, to lay down that a cardinal point in agricultural policy should be the production locally of as large a proportion as is economically practicable of a country's food requirements.

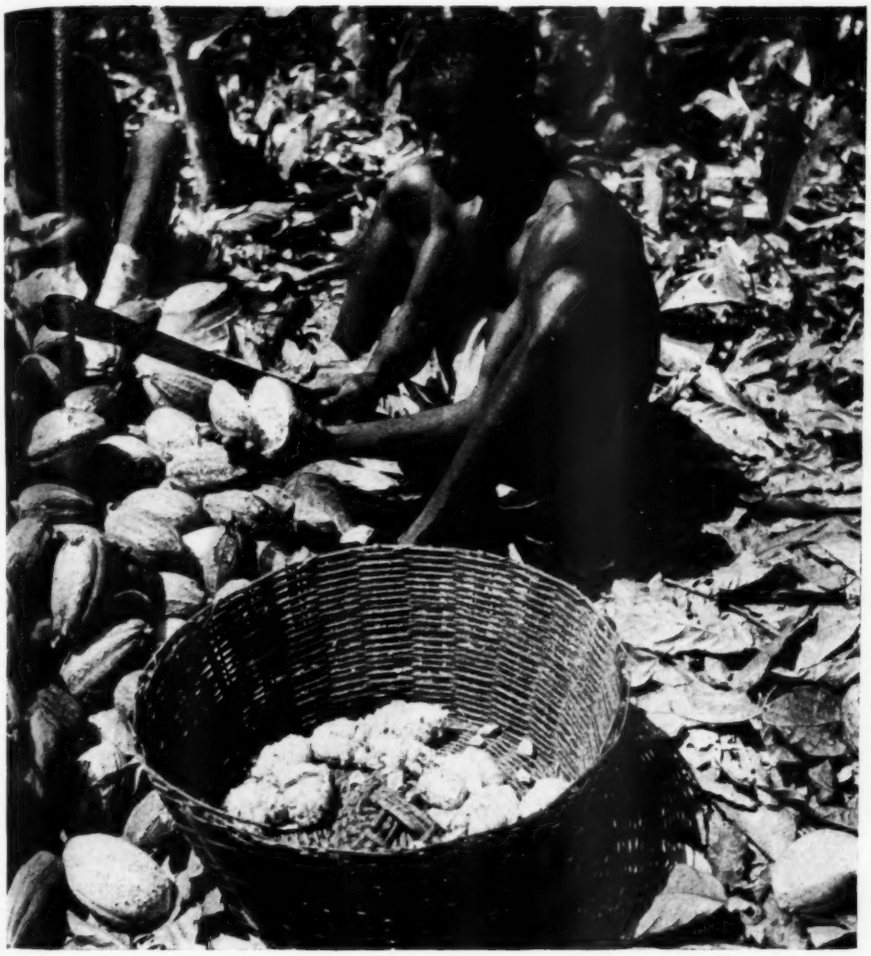
British policy concerning export products

British Government policy was to encourage production of export crops. For one thing, export crops favoured the development of a cash economy and so helped to provide easily taxable resources for the government services. In most dependencies, in the early stages, plantation development was favoured, with due regard to safeguarding the rights of native populations. The main exceptions were the West African dependencies and Uganda in East Africa, where native production was favoured and plantation enterprise discouraged.

One can hardly say that there was much planned development policy. *Laissez-faire* economics were the standard and private enterprise and the rights of the individual were almost sacrosanct; the main role of the Government was to favour development by establishing law and order, ensuring reasonable security of tenure, and providing transport facilities and medical and educational services within the limits imposed by local finance. In the early days, contributions from metropolitan government funds to colonial development were regarded with disfavour and the prime concern of local administrations was to balance local budgets.

There was little appreciation that development might require government guidance, or that unrestricted private enterprise might give rise to dangerous conditions. Tropical soils were thought to be inexhaustibly fertile, and it was not understood that agricultural practices which were standard in temperate countries might cause difficulties in a tropical environment.

The only direct early step to assist development was the establishment of



On a Gold Coast cocoa farm. After the pods are cut from the trees, they are split and the wet beans extracted

botanical gardens to facilitate the introduction of new crops and new plants. They accomplished some important results and served as the basis for the organisation of Departments of Agriculture at a later date.

Plantation production of export crops

Plantation methods were for long the favoured method of expansion. They had some obvious advantages. Undertaken by private enterprise often with considerable capital resources, and stimulated by growing demands for tropical products, plantation production expanded rapidly in the 18th, 19th and early 20th centuries. It led to the establishment of large continuous blocks of cultivation easily supervised and controlled; this facilitated the introduction of improved methods, favoured mechanisation and the control of disease. It also favoured organisation to represent the interests of the owners and mutual collaboration to assist advances. Indeed, many of the advances in tropical agriculture have stemmed from action taken by plantation interests.

On the other hand, there were from the outset inherent weaknesses, and with the lapse of time these have become more evident. Exclusive dependence on one or two products makes for unbalanced agricultural systems, while the same factor makes plantations peculiarly vulnerable to fluctuations in market prices for single staples. Moreover, especially latterly, they are confronted with increasing labour difficulties, large-scale importations of labour are no longer practicable, and though mechanisation is a powerful aid it cannot overcome them all. Difficulties have increased of late owing to insurgent nationalism and political movements. Some authorities have questioned the possibility of the permanent survival of plantation enterprise, at any rate in its present form.

Peasant production of export crops

The production of export crops by peasants in British Dependencies has arisen in a variety of ways. It may have originated as an imitative process, smallholders planting export staples inspired by the example of existing neighbouring plantations often with direct encouragement by governments. Thus the large cane farming industries of the West Indies and Mauritius arose from smallholders taking up lands formerly cultivated by estates, either on a metayage system or by rent or by purchase in instalments, disposing of their canes to the factories from which they acquired the land. Peasant rubber and tea cultivation in Eastern countries is similarly an imitative process encouraged and assisted by governments.

In other cases, they have originated as the result of peasant initiative alone without much government assistance: an example is cocoa cultivation in West Africa, which developed from a chance introduction.

In other cases, they have taken their rise from transport developments; the groundnut industry of Northern Nigeria, for example, is the outcome of the opening of the railway from Lagos to Kano.

Finally, they may have arisen as the direct effect of government or private action; the cotton industry in Uganda, Tanganyika and other parts of Africa is a case in point; this developed in consequence of fears by Lancashire spinners concerning the danger of relying too greatly on foreign sources of supply, which led to the establishment of the British Cotton Growing Association and later the Empire Cotton Growing Corporation to assist developments working in co-operation with local governments, through the local departments of agriculture which had then been recently formed.

Developments were very largely uncontrolled and haphazard. The assumption was that cash crop production could be superimposed on the traditional native subsistence farming, based on shifting cultivation, without specific measures to guide or assist the integration. There was also lack of appreciation of the risks of shortening the rotation by reason of the introduction of additional crops and of the increasing population pressure.

Difficulties and needs were dealt with *ad hoc* as they arose, often with little regard to the future. Thus the erection of cotton ginneries by private enterprise in Uganda was permitted in numbers far exceeding the real need, with evil effects that are still felt.

It was not appreciated that changing conditions might necessitate changes in land tenure or control over the location of smallholdings. As a result, peasant cultivations sprang up scattered in small isolated patches over the countryside. This

created great difficulties when questions of introducing methods of controlling crop diseases arose, as was seen for example in West Africa when it came to attempts to control ' swollen shoot ' disease of cocoa.

Nor was it realised until the 1920s that inevitably increasing population densities must involve the replacement of extensive shifting cultivation by intensive farming on fixed areas and the integration of shifting cultivation and extensive nomadic grazing into mixed farming systems. Since then there has been much experimentation and numerous efforts to introduce new systems on a limited scale by persuasion, with some though limited success, notably in Nigeria and also in parts of East Africa.

Marketing peasant produce, usually ill-prepared and disposed of to native traders, was another difficulty. Abuses became rampant and various measures to improve matters were suggested. Numerous commissions considered various aspects, but usually their recommendations were not implemented or only partially so, owing to British unwillingness to impose methods of compulsion. It was only the compelling exigencies of war that led to the evolution of the present marketing schemes for certain classes of peasant produce in West and East Africa. Finance for peasant agriculture was another source of trouble; co-operation has become accepted as the remedy, but with a few exceptions it has not yet achieved widespread success.

To sum up, although many hold that the future of export production lies with the smallholder rather than with the estate, his natural disabilities are a severe handicap. Left to himself, he is a low-cost but inefficient producer and his returns per unit area are excessively low. That they can be greatly raised by the application of modern discovery is obvious, but without a great modification of conditions, including a measure of grouping and overall control to enable working with something of the efficiency of the large estate, it is hard to see how the improvement can be achieved.

In British dependencies, the present position is largely the result of past errors and omissions, coupled with traditional unwillingness to impose controls over cultivators, particularly native cultivators. The correction of past mistakes is often more difficult than starting *de novo*; settlement and resettlement schemes have of late been much favoured, usually on the basis that food crop production and cash crop production must be integrated into intensive agricultural systems, with adjunction of provision for making implements, fertilisers and guidance and advice readily available to cultivators, combined with centralised processing, marketing and finance. Many hold that nothing less than an agricultural revolution is needed and favour publicly owned corporations as the most promising approach. An example is the Mokwa project in Northern Nigeria sponsored by the Colonial Development Corporation. Others favour Government-controlled schemes, examples being the schemes recommended by the West African Oilseeds Commission in 1948 or the Uganda Development schemes. A development which has attracted attention is the peasant cane farming schemes successfully developed by the Colonial Sugar Refining Company on their properties in Fiji. This, however, only provided for producing sugar cane and took no account of food production.

Developments in non-British countries

It is of interest briefly to review some developments elsewhere than in British dependencies.

Indonesia

Developments under Dutch influence in what is now the Republic of Indonesia provide an interesting contrast. From 1816 to 1870 the emphasis was on export production mainly for the benefit of the mother country under the ' Kultur system.' In the latter year, policy was altered and embodied in the Agrarian law subsequently amended by additional enactments. Under these the production of food to meet the needs of the native population was given first place, export production coming second. Food production became the principal concern of the indigenous population, while export crop production on a plantation scale was encouraged. To secure this all land to which pre-existing title could not be proved was regarded as State land. Once requirements for food production were satisfied surplus land could be leased to plantations for export crop production. Safeguards were provided to ensure proper land use, and scientific services to assist agriculture developed early. Thus the sugar Proef Station was established in 1880. The system was first developed in Java and Madura and afterwards extended to the outer islands with some modifications. Under it the population of Java expanded from 9½ millions in 1850 to over 47 million in 1940, while that of the whole of Indonesia grew to approximately 70 million. Self-sufficiency in food amounted to 94% of total requirements, while export agricultural production far exceeded in bulk and diversity that of any other tropical country of comparable size. In Java, it was mainly derived from estates although there was also appreciable smallholding production of certain export crops in the outer islands, peasant production of export crops, particularly rubber and copra, was much more considerable. Latterly increasing concern was felt at the heavy population pressure in Java, and by 1940 organised population transfer schemes to the outer islands on some scale were operative. Nevertheless, erosion and similar ill effects were much less manifest in Java than in many other tropical lands. It is true that the soils of Java are inherently more fertile than those of most tropical countries, while the developments involved a degree of authoritarian control over agriculture repugnant to some British ideas; nevertheless, they provide an example of the successful integration of food and export production.

Anglo-Egyptian Sudan

The Sudan Gezira scheme is an example of planned development in which the large-scale production of an export crop (Egyptian cotton) by peasant cultivators has been successfully integrated with food production—sorghum and a leguminous fodder crop, lubia (*Dolichos lablab*).

Originally started as a tripartite scheme between a private company (the Sudan Plantations Syndicate), the Sudan Government and the peasant cultivators, it depended on the cultivators occupying their holdings on the condition that they followed the instruction issued to them by the Government and the Syndicate, the Government providing the irrigation water and scientific services, the Syndicate performing major cultural operations, carrying out pest control, and providing facilities for ginning and handling the cotton crop and for its subsequent disposal. The scheme was modified in 1951, when the Government took over the functions previously performed by the Syndicate. Throughout the basis was scientific experiment, both in the preliminary stages and subsequently. Without this it could not have succeeded. The scheme achieved remarkable success and although admittedly specialised, provides an example, with suitable modifications, of a basis for ordered development elsewhere.

Another Sudan project worthy of mention is the Zande Scheme in the remote southern region of that country, which aims at creating a planned self-sufficient native economy based on the growing of cotton and its manufacture into cloth for local sale, combined with the growing of food crops.

Harvesting sugar cane in Barbados

French Equatorial Africa

The Sansanding scheme in the Niger bend in French Equatorial Africa is an example of projected development on lines somewhat similar to those in the Sudan. The scheme is based upon the cultivation of cotton and rice in a rotation under irrigated conditions by peasant cultivators. The scheme cannot as yet be said to have achieved complete success, partly owing to the difficulty of attracting suitable cultivators.

Belgian Congo

Developments in the Belgian Congo have followed mainly the principles adopted by the Dutch in Indonesia—namely, the encouragement of food production by native African cultivators and the development of export crops, notably palm oil on plantation lines. Native development has been concentrated on evolving modifications of shifting cultivation, which would lead to a stable economy, and has resulted in the working out of the so-called corridor system whereby successive strips of jungle are cleared and cultivated in food crops on a prescribed succession for a few years and then allowed to revert to forest once more. Recently they have embarked upon a 15-year plan for the production of certain export crops by natives on controlled lines.

Discussion

One may conclude that both plantation agriculture and native agriculture on traditional lines have elements of instability which must be modified if needs are to be met and the future rendered more secure. The need for overall integration of the production of food crops and cash crops and the preservation of a proper balance between the two is paramount in view of increasing world food shortages. Incidentally, under existing conditions high prices for certain export staples appear likely to detract from food production notwithstanding the obvious dangers.

Plantation development seems unlikely to extend greatly and in any case needs greater diversification; nevertheless, in the view of the writer, its rapid decline or disappearance in the immediate future is unlikely, although with increasing nationalistic trends the gradual transference from outside to local ownership may occur. In any case, although diversification is needed there is a strong case for keeping lands specially suited to certain crops, such as rubber, cocoa or tea, predominantly under them rather than attempting to develop them under more diversified but less suitable forms of cultivation.

The rationalisation of peasant agriculture is more urgent and more difficult. Some form of grouping to enable more efficient production and operation with some of the efficiency of a large estate is essential. Various methods of doing this have been mentioned; they all involve a greater or less measure of settlement or resettlement. The possibility of compulsory collective resettlement on a co-operative basis, which has gained such prominence in the U.S.S.R. and its satellites, needs a reference. Unfortunately, the subject has been so befogged by ideological and political propaganda and controversy that objective treatment is difficult. Nevertheless, the possibility must not be overlooked. In any case, any form of grouping demands the assumption of much greater control over peasant settlement and agricultural operations than was formerly thought necessary or expedient. Furthermore, in any planned scheme of development based on resettlement there should be exact knowledge of the physical characteristics and the suitability of the area intended to be settled. The form of agriculture to be practised should be decided and its details worked out by experiment. There must in fact be adequate advance planning based on full knowledge of the conditions, and there must be ample provision for research and skilled advice throughout. The success which has attended the developments in the Sudan Gezira is proof of this if any were needed, and to the absence of adequate advance information may be attributed in large part the costly failure of the original groundnut project in Tanganyika.

With all this must be coupled understanding of the cultural and sociological make-up of the populations to be settled, and satisfactory arrangements for the actual settlement and subsequent working, including land tenure, the processing and marketing of produce and so forth, as well as the education of populations to the need for the change.

The difficulties cannot be minimised, but it is impossible to avoid the conclusion that if they are not resolved the continued production of export crops to meet expanding needs, as well as the production of increasing food supplies for growing populations, can hardly be achieved.

(*From the Empire Cotton Growing Review.*)

Amman Locust Conference

The emergency created by the latest developments in the present desert locust plague which threatens the Near and Middle East and Africa brought new and immediate international co-operation at a meeting held recently at Amman, Jordan. The purpose of the meeting, which was convened by the Jordan Government, was to decide on immediate emergency measures to control breeding of locusts in southern Jordan and northern Saudi Arabia. If these breeding swarms are not controlled, there would be grave danger of heavy invasion in the late spring and early summer, throughout the whole region from Egypt to Iran.

Countries represented at the meeting were Jordan, Iraq, Lebanon, Saudi Arabia, Syria, and Turkey. In addition, the British Desert Locust Control Organisation, the United States, and FAO were represented.

As a result of this meeting, various international units have moved into Saudi Arabia from Jordan, Syria, Lebanon, Turkey and also Egypt. These missions now are co-operating in the affected area with the Desert Locust Control, which already operates in Saudi Arabia. The FAO, too, was able even before the Amman Conference to help Jordan with considerable equipment from the organisation's special pool.

The Ring Culture Method

DR. J. R. BOOER

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This article describes a newly devised method of raising greenhouse crops which appears to offer possibilities as an alternative to the established procedures in hydroponics. It was devised at the Tilgate Research Station of F. W. Berk and Co., Ltd.

THIS is an example of an *ad hoc* research programme which gave totally unsuspected results. It started at the research station of F. W. Berk and Co., Ltd., Tilgate, in 1946 as an investigation into blotchy ripening of glasshouse tomatoes, a disorder which causes serious losses and for which no complete cure has yet been found.

The method

As this work progressed, it became clear that one of the principal causes of blotchy ripening was an undue strain on the root system. It was therefore decided to study the effect of a restricted root system as compared with one which was as unrestricted as possible. To this end tomatoes were planted in 10-in. Raschig rings, familiar to most chemical manufacturers. The rings were filled with John Innes potting compost; half were placed on asbestos cement sheets, the other half being on an ash base, through which the tomato roots could wander freely.

This experiment gave the expected result that blotchy ripening was much more severe in the plants with restricted roots, but it gave another result which fortunately did not escape attention. The yield of fruit from the plants with unrestricted roots was the highest ever recorded at Tilgate. As this experiment has since been repeated, it can now be stated that the yield was 21 lb. of fruit per plant, or at least three times the normal.

Physiological aspects

An examination of the circumstances disclosed the fact that an important aspect of plant physiology was involved. The average glasshouse tomato plant requires, very roughly, 1 oz. of mineral nutrients and some 300 lb. of water during its lifetime. The task of supplying these widely differing requirements is normally placed on one root system. By the ring culture system, the plant is virtually provided with two root systems, one in the soil in the ring supplying the mineral nutrients, and the other much larger system supplying the water from a porous, well-aerated medium. The relation between efficient aeration and water uptake is, of course, well known.

The recognition of these principles and further successful trials, which will be reported later in more detail, made it evident that the ring culture system

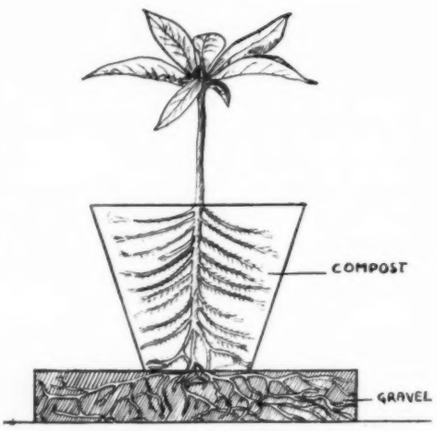


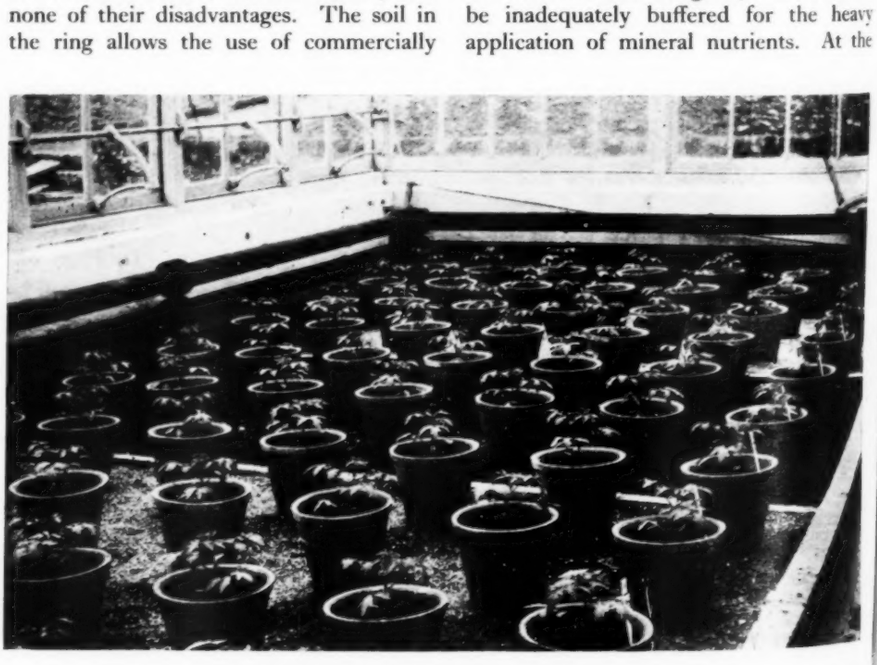
Diagram of the ring culture system

possesses most of the advantages of normal soil cultivation and of soilless culture, with none of their disadvantages. The soil in the ring allows the use of commercially available liquid fertilisers and dispenses with the analytical control necessary in soilless culture. The use of relatively small amounts of soil in the ring reduces soil sterilisation costs. Porous bases such as ash, clinker, sand and gravel eliminate the risk of water-logging and render watering foolproof. If sterilisation of the base is necessary, it can be done more effectively and much more quickly than is the case with soil.

It was also clear that very little, if any, of the prior knowledge of plant nutrition and cultural practice was applicable to the ring culture method. Obviously, the increased yields would necessitate an increased supply of mineral nutrients, but these could not be studied effectively until other optimum conditions had been determined. Among the variables to be studied with each crop were the nature and composition of the compost within the ring, the nature of the inert bases, the minimum weight of compost per plant, the depth of planting above the base, and the selection of the varieties most suitable for ring culture.

The compost employed

Some progress regarding the compost has been made. The standard John Innes potting compost, excellent for the purpose for which it was designed, was found to be inadequately buffered for the heavy application of mineral nutrients. At the



Tomato trial on different bases

end of a tomato season, this compost was found to test pH 4.5. The addition of 5% by weight of limestone grit improved the yield of tomatoes and lettuce. Other modifications to the compost are being investigated.

Regarding the inert bases, the results are in agreement with the work that has been done elsewhere on soilless culture. Provided the base is capable of retaining moisture without becoming waterlogged, its composition appears to be of no great importance. Coarse clinker, fine ash, sand and quarter-inch gravel have been successfully used, and show no significant difference on tomatoes. Trials are also in hand to compare porous bases with normal unsterilised soil, but these must be regarded as long-term experiments.

Work on the minimum quantity of compost per plant has already given most interesting results. The figures in Table I show the relation between the weight of soil and the yields of tomatoes from a late house.

TABLE I

Weight of compost	*Yield of fruit per plant*
lb.	*lb.*
2.0	8.41
4.3	8.96
12.0	12.96
17.0	13.56

It is surprising to see that a normal yield of tomatoes can be grown by the ring culture method from as little as 2.16 lb. of compost, but the main indication from this experiment is that the minimum quantity of compost required for tomatoes is about 14 lb. Confirmation of this figure is available from another experiment in an early house, the results of which are given in Table II.

TABLE II

Weight of compost in ring	*Yield of fruit per plant*
lb.	*lb.*
14	17.96
24	18.55

The difference is not statistically significant.

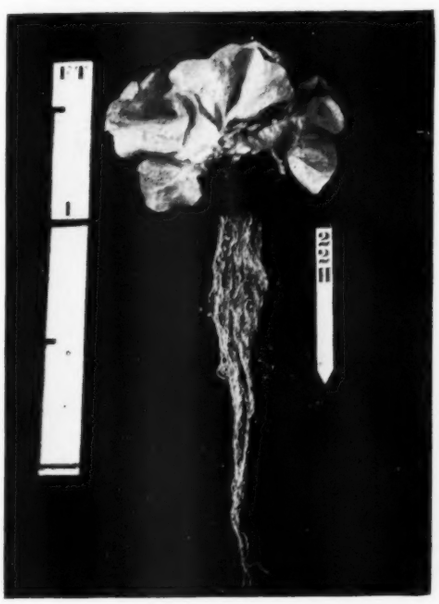
The figure of 14 lb. of compost per plant is of the greatest importance. This weight of John Innes potting compost contains about 10 lb. of soil which requires sterilising. Thus, for tomatoes planted at the rate of 14,000 per acre, it would be necessary to sterilise 70 short tons of loam per acre of glass.

The sterilisation of 1 acre of normal soil to a depth of only 6 in. involves the treatment of about 800 tons of soil. Therefore, whatever method of sterilisation is employed, the ring culture method can reduce the cost of this treatment to a mere fraction.

Typical tomato crop

French beans and lettuce

A further indication of the minimum requirement of compost was given by an experiment with climbing french beans in a cold house, but in this case a fresh variable was introduced. It is known that beans have a high potash requirement and therefore the plants were grown in two sizes of rings and at two potash levels with the results given in Table III.



Lettuce (Trocadero) showing paper ring and secondary root system removed from gravel

TABLE III

	Weight of compost in ring	*Yield of beans per plant*
	lb.	*lb.*
High potash ..	17.0	4.0
	4.3	2.5
Normal potash ..	17.0	3.1
	4.3	2.7

All differences are statistically significant.

These results call attention to the fact that the normal reaction to plant nutrients may not be obtained unless the amount of compost in the ring reaches or exceeds the minimum.

Trials on cabbage lettuce suggest that about 14 oz. of compost per plant are sufficient, and it is interesting to note that when grown on a gravel base the secondary root system is considerably larger than the head of the lettuce. Excellent heads have been grown by the ring culture method and an attractive feature is that losses from *Botrytis cinerea* are reduced to negligible proportions. This may be due to the improved ventilation around the base of the plants.

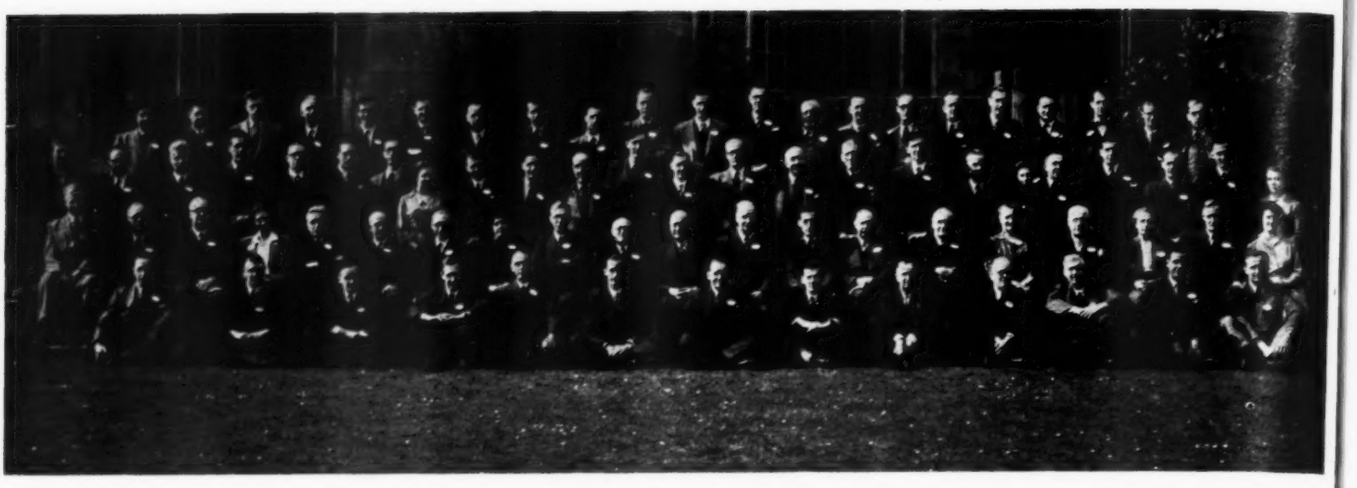
Other aspects

Little progress has yet been made on the subject of the planting depth, although this is obviously a matter of importance. There has been evidence, notably with cucumbers and melons, that the roots may have difficulty in reaching the inert base and diffusing through it. In consequence, the results with these two crops have not yet equalled those obtained in normal commercial practice. However, the general cleanliness of the ring culture method with the associated freedom from insect pests, justifies further work on both cucumbers and melons.

The selection of the most suitable varieties for ring culture should really be undertaken after all other variables have been eliminated, but some preliminary indications are available. The tomato varieties, *Potentate*, *Ailsa Craig* and *Baby Lea*, have all grown successfully. The last named, a short-jointed progeny of *Potentate*, has the reputation of producing some very heavy lower fruit trusses, but the weight from subsequent trusses is sometimes disappointing. However, this effect has not been observed using the ring culture method. The lettuce variety *Trocadero* has been very successfully grown, but certain of the modern forcing varieties have shown a tendency to bolt.

One practical aspect has been investigated. The original Raschig rings would certainly be too cumbersome for the com-

(*Continued on page* 253)



The invited members who took part in the Colston Symposium

The Colston Symposium on Insecticides and Colonial Agricultural Development

The symposium on insecticides and colonial agricultural development, held at Bristol University on March 23-27, must be reckoned as an event of importance. The following summary of the proceedings has been prepared by Mr. R. W. Marsh, who acted as recorder of the conference, and is reproduced with the permission of Professor T. Wallace, C.B.E., F.R.S., the Director of Long Ashton Agricultural and Horticultural Research Station, under whose direction the conference was organised and held.

THE Colston Research Society, an association of Bristol citizens formed to support research in the University of Bristol, has in recent years arranged symposia on research topics of current interest. Eighty invited members took part in the 1953 Symposium, which dealt with insecticides in relation to colonial agricultural development. The conference had the support of the Colonial Office and the Agricultural Research Council and was directed by Prof. T. Wallace, C.B.E., F.R.S., Director of the Bristol University Agricultural and Horticultural Research Station at Long Ashton.

The opening session

In the opening session, Dr. W. J. Hall, C.M.G., of the Commonwealth Institute of Entomology, stated that the 38 British colonies, covering 2¼ million square miles and supporting 70 million inhabitants, employed only 29 entomologists. In 1949, the total value of crops exported from the colonies was £182 million; it was impossible to say how far this could be increased by the control of pests but, as an example, it was known that the control of cotton jassids in the Sudan had given a return of over £4 million for an expenditure of £200,000. Dr. Hall referred to the coming expiry of the Colonial Welfare and Development Act in 1956 and hoped that ample funds would be made available to continue the pest control research work initiated by that Act.

Mr. C. B. Symes, O.B.E., of the Colonial Office, outlined the existing insecticide researches in the British Colonies, emphasising the uses of the chlorinated hydrocarbons in the control of pests of food crops. He pressed for an increase in fundamental work on the specific pests and environmental problems encountered in the colonies.

Mr. S. Callaway, of the Chemical Defence Experimental Establishment, Porton, described the species and distribution of locusts and gave a detailed account of an air-spraying operation in Tanganyika, using a spray of 20% dinitrocresol in oil. In the sprayed area, 4½ million locusts (96% of the original population) were destroyed, using 3½ tons of diluted insecticide.

M. G. Bouriquet, of the French Colonial Service, detailed the organisations set up to control locust attacks in French West Africa and in Madagascar. In these areas, the insecticide chiefly used was a 25% BHC dust.

In the course of the discussion, Mr. E. R. Hoare called for better co-operation between the entomologist and the engineer. Mr. M. J. Way questioned the value of insecticide applications on peasant holdings, where pests were usually much less damaging than in plantations, but Mr. G. Swaine noted the exceptional case of native-grown maize, which was more heavily infected with borer than the plantation crop.

Sir Harold Tempany pointed out that the yields of peasant holdings were exceptionally low and must be increased because population was outpacing food production. Such increase could only be obtained by some measure of control of cropping exercised willingly by the native cultivators. The problem was mainly political and administrative, but could not be evaded. Mr. Leyland Cole mentioned the promising results given by aldrin in locust control, and Mr. R. J. Joyce looked to concentrate sprays to reduce the high transport costs of anti-locust campaigns. Dr. W. F. Jepson asked for improvements in the simple hand methods of spraying and pointed out that Colonial authorities were ready to finance practical schemes of research on pest control.

Mr. K. S. McKinlay described the difficulties imposed by staff shortage in applying existing knowledge to peasant agriculture. Prof. J. W. Munro noted the improvement in recruitment of applied entomologists, and pleaded for more vacation courses for undergraduates at research institutes. Dr. R. A. E. Galley commented that the Ministry of Labour forecast a surplus of general biologists, although there were not enough specialists available; he advocated changes in the methods of training. Mr. W. T. Cowan, replying to Sir Harold Tempany, noted that co-operative societies of cotton growers were developing in Uganda and that Africans were starting to own ginneries, which gave them a direct interest in increasing cotton yields.

Afternoon session

Opening the afternoon session of March 24, Mr. E. O. Pearson, of the Empire Cotton Growing Corporation, named cotton as the principal cash crop in the arable farming of the African. He pointed out that there was only one instance in Africa—the control of jassid on irrigated cotton in the Sudan—where insecticide applications had reached large-scale commercial use. In the rain-fed areas, chemical control might possibly be attempted against American bollworm in eastern Tanganyika and against *Lygus vosseleri* in parts of Uganda and the Congo. The use of insecticides on peasant-grown cotton awaited a more orderly system of farming and an increase in basic yields by improved cultivation and manuring.

Mr. R. S. McKinlay, of the East African Agriculture and Forestry Research Organisation, showed that the conventional design of small field plots was unsuitable for *Lygus* control studies. He described a method using weekly spraying of individual plant rows with DDT and toxaphene to provide insect-free plants for comparison of their yields with those of surrounding *Lygus*-attacked areas. Mr. McKinlay considered that the inevitable delay in extending the use of insecticides to peasant crops gave the entomologists time to devise efficient treatments.

In the discussion, Mr. G. Swaine suggested that Mr. McKinlay's figures on insect-caused crop losses should be widely publicised among colonial administrators. Mr. Joyce listed direct effects of DDT on cotton plants in the Sudan—increased leaf area favouring whitefly development, and retarded fruiting following the suppression of jassid-induced premature boll formation. Dr. Jepson suggested a plan for reducing American bollworm by segregating cotton from maize in peasant cultivation.

In comparing U.S.A. with African cotton growing, Mr. Pearson recorded that American yields, being ten times greater than those in Africa, could carry a much higher cost of spraying. Dr. Holmes pointed out that much of this spraying was done with aircraft bought for £17 each. Answering Sir Harold Tempany, Mr. Pearson said that toxaphene was approximately equal to DDT in bollworm control. Mr. Cole deprecated the use of over-crude methods for applying the potent modern insecticides, and called attention to the use of aldrin, dieldrin and endrin in cotton pest control.

Mr. Cowan suggested that co-operation of peasant cultivators could be anticipated in the future and mentioned developments in the Congo. Mr. Pearson explained that in the Belgian Congo a much greater degree of direct control of agriculture was adopted than would be tolerated in British Colonies. Mr. Emery considered that the peasant cultivator who wanted higher yields would plant a wider area rather than buy a sprayer.

Mr. Joyce advocated more use of air-sprayed concentrates even on peasant holdings, but Mr. Pearson pointed out that what was feasible in the Gezira was impracticable elsewhere in Africa. Mr. McKinley concluded that the peasant cultivator could be taught to use insecticides, but that it would be a long process and by no means a cheap and easy solution to colonial crop problems.

Second day

On the second day, with Sir Harold Tempany in the chair, the first paper was given by Mr. G. Swaine, of the Department of Agriculture, Tanganyika, who recorded that treatment of cotton with 10% DDT plus 3% BHC, applied five times, greatly increased yield by controlling American bollworm. On coffee, the Pentatomid bug *Antestia lineaticollis* was now widely controlled in East Africa by DDT emulsion. Contact insecticides had given striking results when applied as seed dressings or mixed with the soil, *e.g.* BHC against termites or sugar-cane white grubs; aldrin and BHC against the wheat pest *Heteronychus consimilis*; and toxaphene against cutworms.

Mr. M. J. Way, of Rothamsted Experimental Station, described certain ecological balances between pests and predators that might be adversely affected by insecticides. In Zanzibar, the *Theraptus* bug attacking coconut palms was often kept in check by a predatory ant. This ant, however, encouraged the mealy bug suspected of being the vector of a virus attacking clove trees. A similar relationship between ants and mealy bugs existed on cacao in West Africa.

Mr. J. Bowden, of the Agricultural Department, Gold Coast, in a paper on some West African crop problems, dealt principally with pests of the native-grown food plants, maize, sorghum and millet.

In the discussion, Dr Jepson noted that the dosage of BHC for white grub control in Tanganyika was 8 oz. of a proprietary material per 50 ft. run of furrow at planting. He asked for information on groundnut pest control. Mr. Swaine replied that systemic insecticides rendered plants aphicidal for about 40 days, and seed treatment with schradan gave 15 days' protection. Mr. Joyce noted the effectiveness of BHC against cockchafer grubs in soil, but Mr. Jepson added that this was an inhibition of feeding not an insecticidal effect.

Dr. W. J. Hall, answering Prof. Munro, said that *Pseudococcus njalensis*, the principal vector of cacao swollen-shoot, was indigenous to West Africa, but two minor vectors occurred both in West and East Africa.

Mr. L. W. Cole, remarking on the residual effects of insecticides, suggested that incorporation with soil might be more effective than seed dressing, but Dr. Holmes stated that seed dressing with BHC used only one-tenth of material compared with broadcasting and still showed residual effects. Mr. Hoare noted that machines placing fertilisers beneath seed crops were now available.

Mr. Greenwood showed that dwarf sorghums could not be successfully introduced into Northern Nigeria unless stem borer could be controlled. Mr. Bedford listed some of the disadvantages in using dusts for cotton pest control.

Mr. Thompson instanced examples of co-operation between entomologists and local populations on tsetse and locust control. Mr. Swaine concluded with a comment on phytotoxic effects of BHC on tobacco seedlings in Rhodesia.

Afternoon session

In the afternoon, a paper by Mr. R. G. Fennah, of the Imperial College of Tropical Agriculture, Trinidad, was read by Mr. D. B. Murray. Mr. Fennah considered that the inefficiency of West Indian agriculture was of overwhelming importance compared with the toll exacted by insects. The successes that had so far attended the use of insecticides in the British Caribbean territories were the suppression of the sugar-cane froghopper in Trinidad and

the simplification of parasol ant control. The most obvious lacuna was the absence of effective chemical protection of citrus against fruit-puncturing moths.

Prof. J. W. Munro, of the Imperia College of Science, warned the conference that the transfer of native labour from subsistence agriculture to industry brought famine nearer, unless satisfactory storage of foodstuffs could be provided. Much knowledge on fumigation and other methods of infestation control was available, but the urgent need was to use this knowledge. He called for improvements in storage and transport methods to facilitate control and emphasised the importance of training selected Africans and West Indians as technicians in the practice of storage pest destruction.

In the discussion, Mr. May suggested that the accumulation of food stocks necessitated a replacement of bulky non-storable products such as bananas and sweet potatoes by grain. Dr. Jepson hoped that the development of agriculture as a subject for study in African universities would be encouraged by providing sufficiently attractive posts in agriculture for trained Africans. Mr. D. W. Hall asked for more research on methyl bromide fumigation, design of equipment and methods of underground pit storage. Mr. Turtle recorded that the Infestation Control Division of the Ministry of Agriculture had given training to 50 African produce officers.

Dr. Fisher called attention to infestations of timber and outlined the activities of the West African timber-borer research team, appointed by the Colonial Office to study infestation in logs before export. Dr. Fisher also reported on the use of DDT and BHC in plywood glues.

Dr. Coyne referred to the work of Dr. Gigliogli in British Guiana where a large increase in the rice-growing area had been made possible by anti-malaria spraying. Dr. Jepson described the methyl bromide fumigation of the groundnut ' pyramids ' at Kano as an outstanding example of co-operation between scientific research organisations, the mercantile community and the local control units in Nigeria.

Mr. Swaine described the pit storage in Tanganyika which depends on the hermetic sealing of a bulk of dried grain which by its respiration produces enough carbon dioxide to act as a fumigant. In such pits, rice weevil infestation had been eliminated.

Mr. Emery stated that bagged grain could be protected by suitable impregnation of the sack if the demand for such treatment was sufficient. Mr. McKinlay complained of conflicting statements on permitted tolerances of insecticides in grain, and Dr. Galley replied that the Toxicology Committee of the Medical Research Council now recommended a maximum permissible figure of 2.5 p.p.m. gamma-BHC. The tentative recommended tolerance for DDT was 7 p.p.m. In the United States, DDT was not permitted on foodstuffs. Dr. Coyne pointed out that DDT could, in the United States, be employed in homes but not in cowstalls.

Third day

The morning session of the last day of the conference was under the chairmanship of Dr. A. W. Stableforth. The first paper, read by Prof. Blakemore, was a general review by Sir Thomas Dalling, of the FAO, Rome, of the insect-transmitted diseases of livestock in colonial territories. This was followed by a film and paper by Dr. J. Carmichael, C.M.G., describing tsetse control work, particularly in Zululand, where applications of DDT aerosols have been regularly made from Anson aircraft fitted with special booms. The droplets emitted were approximately 70 microns diameter, the swathe width 55-70 yards, and the deposition approximately 0.25 lb. per acre. After seven such applications in the period September 1950 to January 1951, the percentage reduction in tsetse flies was 98.5% for *Glossina morsitans*, 97% for *G. swynnertoni* and over 99.9% for *G. pallidipes*. The numbers showed no tendency to rise in the ensuing nine months, although it could not yet be claimed that tsetse was eliminated in the treated area.

Mr. H. E. Harbour, of the Cooper Technical Bureau, dealt principally with the control of ticks on livestock. The earlier treatments had been chiefly sodium arsenite dips, which were now losing favour partly because of the appearance of arsenic-tolerant tick populations. In recent years, DDT, BHC and toxaphene had made great contributions to tick control; toxaphene had the advantage of conferring residual protection on cattle. In two areas in Tanganyika, tanks had been installed and compulsory dipping instituted. As substitutes for drips, spray ' tunnels ' were proving effective.

The discussion was opened by Dr. J. C. Matthysse, of Cornell University, New York, who had just returned from a year's work on ticks in Northern Rhodesia, carried out under the auspices of the Mutual Security Agency. Dr. Matthysse dealt principally with the equipment used for pen spraying of cattle and described the work done by itinerant spray teams in Rhodesia. Mr. Symes raised the question of the relation between duration of residual toxicity and formulation of insecticides. Dr. Matthysse replied that the more intensive light effects in Africa led to shorter residual action than in the U.S.A. Mr. Harbour noted that residual effect on cattle was less than on sheep and mentioned that dieldrin showed penetration into the hair cell. Dr. Carmichael considered that the criterion of tsetse fly eradication must be the absence of trypanosomiasis on cattle introduced into the sprayed area. Mr. Courshee asked how a median droplet diameter of 70 microns was obtained and how great was the recovery of emitted material. Mr. Symes replied that the droplets were obtained as a result of the designing of pumps and nozzles at Porton to give this specific result.

Dr. Martin suggested that the cost of derris treatment against warble flies might be lowered by the use of synergists. Dr. Allan Campbell referred to the low toxicity of toxaphene against ticks, and Mr. Harbour replied that there were numerous reports on trials under standard conditions but the literature was very scattered.

Dr. Page pointed out that the disappearance of BHC from hairs of cattle was largely due to evaporation, not irradiation: with DDT and possibly other chlorinated hydrocarbons, the effect of light was the main cause of breakdown.

Mr. Harbour, answering Dr. Coyne, suggested that resistance to insecticides was a factor innate in the species and was neither promoted nor checked by any practicable level of dosage.

Afternoon session

The final afternoon session, with Mr. H. J. Jones in the chair, was opened by Dr. H. G. H. Kearns, of Long Ashton Research Station, who stressed that the successful solution of a spray problem must take into account the biological requirements, the spray material, the culture of the crop, the user and the machinery. Active, exposed insects such as locusts and capsids were relatively easy to kill; other pests such as red spider required special spraying techniques to ensure complete foliage cover and wetting. Present designs, particularly of manual sprayers, were capable of much improvement, but low-priced standardised designs could only be produced if large numbers were required. ' Air-flow ' mist sprayers could be used for drift spraying only in exceptional cases such as in locust control; for tree spraying, large volumes of air and a higher volume of spray were necessary. A power duster designed at Long Ashton was now being widely used in Africa. Appreciation by the engineer of the bio-

logists' problems was essential in the development of satisfactory spraying equipment.

Dr. E. Holmes, of Plant Protection Ltd., summarised the magnitude and cost of the search for new insecticides and referred to the difficulties connected with the formulation and analysis of present-day products. He pointed out the necessity for the overseas user to give the manufacturer ample time to ship materials to ensure their arrival when required. Dr. Holmes mentioned the prolonged delays in erecting new plant and the consequent need to anticipate demand some three years ahead. He pointed out that certain insecticides in the United States had been over-produced with consequent disturbance to the world market. He emphasised the benefits that were accruing from the closer co-operation between official research workers and those from industry.

Discussion

In the discussion, Mr. Higgins mentioned that the training of entomologists at the Imperial College included instruction in the use and maintenance of spray machinery. Mr. Hoare emphasised the necessity for obtaining exact data on droplet size and deposition. The National Institute of Agricultural Engineering had now developed an electronic spray deposit analyser and it was hoped that this would be used on a co-operative basis in overseas trials.

Mr. Cole noted that manufacturers have also had to develop analytical techniques for determining spray residues and mammalian toxicities. Prof. Munro noted that engineering firms were not usually interested in producing simple fumigation equipment. Mr. Joyce described experiments with low-volume spraying in the Sudan, applying 25% DDT concentrate at just over ½ gal. per acre. Mr. Symes considered that until formulations of insecticides and designs of machinery were based on much more fundamental research, there would be much guesswork in pest control procedures. Dr. Kearns, in conclusion, supported this contention and said that exact data on the insect-plant relationship must form the basis for intelligent spraying.

Conclusion

Throughout the conference, the outstanding value of co-operation between home and overseas workers was apparent, and it was made clear that one of the pressing tasks in colonial entomology was the problem of reconciling peasant agriculture with modern methods of pest control.

Sir Herbert Broadley addressing the delegates at the opening session of the FAO Rice Conference

The FAO Rice Conference

AS previously announced in WORLD CROPS, the special rice meeting convened by FAO took place in Bangkok during the month of January, terminating on January 16. The meeting is reported to have been highly successful, the general note having been one of cautious optimism. The conference was held under the chairmanship of Sir Herbert Broadley, Deputy Director-General of FAO. The greatest benefit derived from the meeting is believed to have been the opportunity given to representatives of exporting and importing countries to exchange views and to appreciate many problems that are confronted by many member states of the conference. The conference included over 70 delegates representing Australia, Burma, Ceylon, Cuba, Equador, France, Germany, India, Indonesia, Italy, Japan, Laos, the Netherlands, Pakistan, Portugal, Thailand, the United States, the United Kingdom and Vietnam.

Agenda of the conference

The most important items on the agenda at the conference were the rice policies of the various governments, including long-term production policies; the provision of economic incentives for increases in rice production; better credit facilities; improved land tenure, etc.; marketing methods and their improvement; technical assistance and arrangements for further consultation on a more permanent basis.

To aid the conferences and its delegates a series of memoranda were prepared and placed in the hands of members in advance on the various points which were to be discussed.

Results of the conference

One encouraging factor was a forecast that the price of rice in the world markets in 1953 might possibly be lower than in the previous year owing to slightly larger quantities of rice having become available for export, while the import demands are likely to be smaller inasmuch as some rice-producing countries have had a better crop during the past season. In regard to the Far East, Mr. B. Majumdar, of the FAO Secretariat, stated that if the plans in prospect were fully implemented by the various governments, it was then possible that rice supplies within the next five years *might* surpass the growth of population. At the same time, however, there was very little room for complacency.

Mr. S. D. Fonseka called attention to the wide variation existing between prices charged for rice in straight government-to-government sales and those operating in private sales. He urged that all rice sales should be made on a government-to-government basis, even if the price looks above those ruling at present. He also urged that available export supplies should be distributed in such a manner as to enable all rice-dependent countries to provide substantially equal rations to all their consumers.

From the seller's point of view, Mr. U. Thet Su of Burma, said that exporting countries had to bear in mind the need for raising the standard of living in their own countries; he considered that the restoration of international allocations of rice would not be practical policies unless all commodities in short supply were allocated on a world-wide basis.

Progress in Apple Production in Italy

(From our Rome Correspondent)

AN important conference to promote the production and consumption of apples was organised in the Ferrara Province of Italy at the end of January by the local chamber of commerce. Ferrara produces the best fruit in Italy; its good climate, excellent soil and husbandry methods have made this town the centre of the national fruit industry.

The development of fruit cultivation has taken place only in recent years and the industry has benefited from recent progress made in foreign countries and in Italy. Apples hold the premier position in production. In 1952, for instance, this zone produced 2,276,750 metric quintals of apples, 190,000 m.q. of pears and 200,000 m.q. of peaches.

The conference was characterised by papers by a number of well-known scientists and experts. Professor Murneeck spoke on the practical utilisation of hormones in fruit cultivation. Hormone products are mostly employed to avoid fruit drop before picking time. Many growers utilise for this purpose naphthalenacetic acid in 0.001% and 0.1% concentrations. Treatment starts as soon as the fall of sound fruits is observed, and the duration of the effect ranges between seven and fourteen days according to the season. If the fruits are not immediately picked, new applications are made after one-week intervals.

Since the effects of the naphthalenacetic acid are of only short duration, other and more advantageous hormone products have been studied. When apples of the Winesap group are treated with 2,4 chlorophenoxyacetic acid, the fall is considerably reduced and almost eliminated within four to six weeks: only one treatment is then necessary. The best concentration is five to ten parts per million.

Another chemical hormone has also attained success, *viz.*, 2,4,5 trichlorophenoxypropionic (2,4,5-TP), which seems to reduce premature fruit fall and increase the red colour of the fruit. When employed at the recommended concentration of 20 parts per million, it prevents fruit fall for 30 to 40 days without doing any harm to the trees, but this product must be used with caution during the greater part of the summer. Experimental tests are being carried out to determine the relative values of 2,4,5 trichlorophenoxyacetic acid and naphthalenacetic acid in accelerating the ripening process.

For thinning apples and pears, chemical treatment is becoming more and more popular, caustic sprinkling when the trees are blossoming or a hormonic treatment after pollination and fruiting being employed. These two methods are known as blossom thinning and fruit thinning respectively. For the first treatment, dinitro-orthocresylate of sodium during the first or second day of full blossoming is used, but hormone treatment is more popular. The same product—naphthalenacetic acid—that reduces or avoids the premature fall in autumn is utilised to increase the fall of fruit in springtime and effect the desired thinning.

Professor Breviglieri spoke about some new problems of fruit cultivation. Fruit growing is practised in Italy on about 800,000 hectares as a specialised crop and on 2,700,000 hectares as a promiscuous crop. The productive increment has been considerable as can be seen from the following figures in metric quintals.

Crop	1935-38	1950	1951	1952
Apples ..	2,700,000	5,300,000	7,200,000	9,300,000
Peaches	2,300,000	2,900,000	2,900,000	3,900,000
Pears ..	1,900,000	3,000,000	3,600,000	3,950,000

Exports developed during 1949-50 but have since fallen.

Among the best varieties of apples produced in the Ferrara zone are the so-called Abbondanza, a prolific yielder; the Champion, a winter variety that ripens from December to May; the Delicious; the Durelle, appreciated because of its keeping properties; the Imperatore—or Rome beauty type—a variety that produces large spherical fruit; and the Rambour Franco, appreciated because of its bright colour and good eating quality.

Other aspects of fruit cultivation in Italy comprise pruning, the use of fertilisers and the control of pests and disease. On all these branches, experimental work is in progress at the Centro Incremento Frutticultura Ferrarese. Courses of instruction in horticulture and fruit growing are organised for the benefit of growers and labourers in the industry by the Navarre Foundation.

Colombo Plan Trainees' Visit

To apply to their own countries' need of increased food production the latest British methods of crop protection, 17 Colombo Plan students from India, Indonesia, Pakistan, Ceylon and the Philippines are to study the methods of crop protection with Pest Control Ltd.

They were welcomed by Dr. W. E. Ripper, the managing director and other officials of the company with whom they will spend six months, and told of the intensive course planned for them in theoretical and practical application of Pest Control's methods.

During the first ten days of the students' stay they will be briefed in general principles, following which they will be attached for practical work in the field to eight of the company's branches throughout the country. There they will learn handling and storage procedures, the special precautions to be taken when using toxic chemicals as well as spraying machinery maintenance and repairs.

Mr. Raschid Ibrahim, Deputy Secretary to the Ministry of Economic Affairs, Pakistan Government, who was present at the welcoming ceremony, said that even countries like Pakistan which, before the war, had exportable food surpluses, had now a need to produce more and more food with which to satisfy the demands of their own peoples. He acknowledged that this course for students had a special significance with its lectures and demonstrations in entomology, insecticides, herbicides, fungicides, foliar nutrients, plant pathology, nematology and spraying machinery.

The students on their arrival at the Cambridge headquarters of Pest Control Ltd. In the centre is Mr. G. B. Thompson, the officer in charge of training

RESEARCH DEVELOPMENTS

Mineralisation of Organic Nitrogen in Soils

In a Dry Weather, Mediterranean Area

In a short paper read at the French Academy of Science (*Comptes Rendus*, 1953, 236 (5), 524-26), G. Drouineau and co-workers record monthly determinations since 1948 of the mineral nitrogen content (nitric and ammoniacal) of arable soils in the coastal regions of south-east France. The following facts are summarised: (1) The maximum content of mineral nitrogen occurs in the dry season in August-September. (2) It may be very appreciable in absolute value, especially in soils that have previously had applications of organic nitrogen manures. (3) Increase in mineral nitrogen content occurs in the top layer of soil, with a maximum between 2 and 6 cm. of depth. (4) Moisture in the soil in this region is always low from July onwards, and is generally less than 6%, *i.e.* insufficient to maintain micro-organism activity in calcareous clay soils.

The mineral nitrogen content at any moment depends, of course, on equilibrium between gains and losses. Gains are usually considered as arising from microbial activity, and losses in bare soils as due to washing out or to micro-organisms. During this period, however, losses by lixiviation are excluded, and conditions are generally unfavourable for microbial activity. In the authors' observations, one of the principal factors appears to be intensification of mineral nitrogen production during the preceding month, when the top 10 cm. layer has already dried, and the average temperature was above 35° C.

It therefore seemed necessary to study simultaneously both *in situ* (field) and *in vitro* (lab.) the possibilities of mineral nitrogen being set free in dry soil in thin layers withdrawn from the possible influence of the subsoil. Various laboratory tests were made in Petri dishes with soils dried in the air. Tests in these open containers showed that the mineral nitrogen content increases with time, namely, from 2.2 mg./100 gm. dry soil to 4.2 mg. in 15 days, and to 5.6 mg. in 30 days (total nitrogen 1.47%). Such an increase is comparable with that observed in open non-irrigated soil between June and August in the Mediterranean region. Rise in temperature up to 70° C. increases the rate of nitrogen liberation. Exposure of these dry soils in shallow layers to the sun produces similar results, but temperatures are much more difficult to control. The amounts of nitrogen set free by this process may be of the same order as those liberated by microbial activity under optimum conditions of temperature and moisture. Under natural conditions these two factors may work in series.

The results reported agree with those of Prescott in Australia, of Yankowitch in Tunisia, of Killian-Feher in the Sahara, and with those *in vitro* of de Rossi. The mineral nitrogen freed under these conditions should be taken into account in a study of nitrogen economy in soils subject to sun exposure in a given climate.

French Exploitation of the Jerusalem Artichoke

At the present time, the artichoke is being intensively cultivated in France as a source of industrial alcohol since it offers certain advantages for this purpose over the potato and sugar beet. One of the conclusions reached by the German expert Griesbeck (*Gordian*, November 10, 1952) is that the French methods of cultivation enable the tuber to compete successfully with sugar beet as a source of alcohol because it involves less labour, even though the actual yields of alcohol per ton may be lower. Figures of 22 gal. and 17.6 gal. per ton for sugar beets and artichokes respectively are cited, but attention is drawn to an increase to 24.2 gal. per ton of artichokes in the spring. High yields of artichokes have been reported, ranging from 20 tons per acre under very favourable conditions to 8 tons on poor soil; in most of the districts in which the tuber is grown the yields compare satisfactorily with those of potatoes. Thus in the department of Deux-Sèvres, the centre of the artichoke industry, 4 tons of potatoes are raised per acre as against 8 tons of artichokes. The ratio is even more favourable in the department of Vosges (3.6 tons potatoes to 12 tons artichokes) and in the Basses-Pyrenès (2.8 tons potatoes to 8 tons artichokes). Experiments with improved varieties of artichokes are in progress at the Venours Agricultural School.

Fermentation of the fructose in the artichokes is effected, using special strains of ferments during the period mid-December to March. The spirit obtained is free from foreign odour. The product from the various district distilleries is further processed at a central plant in Melle, which also produces the special ferments and works up the Jerusalem artichoke into syrup form.

Coastal Flooding Committee

The Home Secretary, the Secretary of State for Scotland, the Minister of Housing and Local Government and the Minister of Agriculture have appointed a committee with these terms of reference:—

(i) To examine the causes of the recent floods in the coastal areas of the North Sea and the possibilities of a recurrence either there or elsewhere in Great Britain.

(ii) To consider what margin of safety for sea defences would be reasonable and practicable having regard on the one hand to the estimated risks involved and on the other to the cost of protective measures.

(iii) To consider whether any further measures should be taken by a system of warning or otherwise to lessen the risk of loss of life and serious damage to property.

(iv) To review the lessons to be learned from the disaster and the responsibilities, administrative and financial, of the various bodies concerned with providing and maintaining the sea defences and replacing them in the event of damage;

and to make recommendations.

The following have agreed to serve on the committee: The Rt. Hon. Viscount Waverley, G.C.B., G.C.S.I., G.C.I.E., F.R.S., Lord de Ramsey, Sir Donald Fergusson, G.C.B., Sir John Wrigley, K.B.E., Sir Claude Inglis, C.I.E., Prof. Proudman, F.R.S., Prof. Steers, Mr. A. S. Quartermaine, C.B.E., Mr. R. G. Leach, C.B.E., and Mr. T. Yates.

The Ring Culture Method

(*continued from page* 247)

mercial grower, and alternatives were tested. For the longer-period crops such as tomatoes, fibreboard bottomless pots have been found to last the season. For the shorter-period crops such as lettuce, paper pots without bottoms are equally successful. Bottomless cement pots have also been found satisfactory and may have uses in special cases.

Conclusion

Whilst many problems remain to be solved, it is felt that the ring culture method already offers English glasshouse growers the prospect of bigger crops at lower cost. Especially where the problem of resoiling may arise, the gradual transition to ring culture might be considered, and the possibility of applying the method to tropical crops, though as yet unexplored, has not been overlooked.

NEW BOOKS

The Farm Workshop

By H. J. Hine, B.Sc., A.I.Mech.E. Pp. 245. Illustrated. Crosbie-Lockwood, London, 1953. 15s.

This useful handbook has been written primarily for the farmer who requires as a workshop a simple building where he can repair his machines or concentrate on home-made equipment, rather than for the fully qualified engineer; in consequence, it concerns itself mainly with descriptions of simple hand tools and their use and the application of well-known standard processes on the farm. Certain types of the more advanced tools that are needed from time to time are also dealt with and also the cautions and techniques that must be made use of if they are to give the best results and the time and skill of the mechanic who uses them well to be efficiently employed. It is admitted in the preface that repair and constructive work is best done by an implement repairer rather than by the farmer, but at least farmers and farm workers should possess a working acquaintance with the methods and the tools employed.

The book will be found of great use not only by farmers in the United Kingdom but also in many other countries, especially in those in which conditions are still primitive and workers have to rely on their own labour and skills for the accomplishment of many technical jobs. To all such people the book should be an invaluable guide and aid, and its relatively low price should place it within the reach of all. The book is well printed and is illustrated with 142 half-tone illustrations and line drawings in the text.

Entoma

A Directory of Insect and Plant Pest Control. Pp. 448. The American Association of Economic Entomologists, 1952. $2.00.

In the foreword to this publication it is stated that it is designed to aid manufacturers, entomologists, plant pathologists and others interested in plant pest control to obtain information which is often difficult of access.

It contains a vast amount of data concerning insecticides, fungicides and herbicides, the manner of preparing them and using them, the risks attending their use and the machinery employed in applying them, together with information concerning all matters affecting the use of pesticides in the U.S.A. and the names of officials, individuals and commercial firms connected with their production, use and distribution. There are numerous advertisements, but it is stated that only advertisements have been included of companies which the editors feel are reliable. The editor-in-chief is Dr. G. S. Langford of the Department of Entomology of the University of Maryland, assisted by an editorial committee of nine which includes such well-known names as R. C. Roark, E. M. Stafford and E. A. Walker, while contributors and collaborators have been drawn from all 48 States of the Union.

The publication is therefore an invaluable source of concise information on this important subject, and can be cordially recommended.

The Wealth of India

A Dictionary of Indian Raw Materials. Vol. III (D-E). Pp. I + 236. Illustrated. Council of Scientific and Industrial Research, New Delhi, 1952. Rs. 18.

The third volume of the encyclopaedic production, entitled the ' Wealth of India,' a copy of which has just reached us, is a worthy successor to the earlier volumes which have preceded it, and in the manner of its presentation even marks an advance on them inasmuch as it appears to be completely free from any of those minor blemishes which detracted somewhat from the excellence of the previous volumes. On this occasion, both subject matter and presentation are alike excellent and provide ample evidence of the erudition and knowledge which have gone to the compilation of the numerous articles and the meticulous care with which the editorial duties have been performed.

The subject matter on this occasion comprises articles falling under the letters D-E; by reason of alphabetical accident the subjects treated, from the vegetable point of view, are of less importance and significance than some of those dealt with in the previous volume such as the masterly and comprehensive articles on coconuts, tea, coffee, but this is no occasion for criticism, especially as many of the articles show the same high standard of knowledge as previously. In particular may be mentioned the article on *Elletaria* (Cardamons), a product concerning which there is comparatively little published information available outside India, or the remarkably up-to-date article on the water hyacinth, *Eichornia*, or the long and beautifully illustrated treatise on the various species of *Dioscorea* (yams) met with in India. Once again, there is a series of beautifully executed coloured plates.

The only complaint we have is that resources do not enable new volumes to be issued except at yearly intervals. We gather that the work is expected to be complete in some ten volumes and, accordingly, at the present rate of progress, it would seem that completion is unlikely to be attained before 1960 at the earliest. This seems a pity in a way although none would willingly concur in a lower standard of performance to achieve more speedy publication.

Indian Plant Protection

Plant Protection in India. Pp. viii + 119. 3rd edition. Imperial Chemical Industries (India) Ltd., Calcutta, 1952.

This is the second edition of a booklet first issued by Imperial Chemical Industries (India) Ltd. in 1947 and intended to supply, in convenient form for Indian users, everyday practical information concerning the nature, use and methods of applying plant protection materials. It is divided into ten sections and contains much useful information in convenient and readable form. The subjects treated include some recent advances in plant protection, the action and use of plant protection materials, the disinfestation of stored products, spraying and dusting equipment as well as a valuable tabular description of a large number of pests and diseases of crops as well as of weeds. The book is well printed and has a number of excellent illustrations.

Books of this type are common enough in regard to England and the United States but so far as we are aware it is the only one published so far applicable to Indian conditions and in this regard it should be very useful. We think also that it should find application in a number of other countries in the tropics and subtropics. Messrs. Imperial Chemical Industries are to be congratulated on its production.

WORLD CROPS

OUR NEXT ISSUE will include an article on **Education in Tropical Agriculture** by C. W. L. Fishlock, B.Sc., A.I.C.T.A., and an account of **Rice in Roumania** by J. Cardew. **The Witchweeds of Africa** will be discussed in an article by K. Wilson Jones.

Agricultural Problems of the Niger Delta is the title of an article by C. H. Brown which will also appear in this issue, together with a report on **New Zealand Farming.** There will be several additional articles as well as regular features.

FARM MACHINERY

Lightweight High-Pressure Sprayer

A new high-pressure sprayer, described as having been specially designed for use in tea, coffee and banana plantations, is the latest addition to the range of sprayers manufactured by the Evesham firm of W. J. Craven and Co. Ltd. Named the 'Hydraulux Minor,' this machine has been designed to bridge the gap between the small low-pressure outfit and the large high-pressure machine. The specification states that the pump is of twin cylinder, vertical construction, driven by an overhead electric shaft. The plungers are fitted with expanding synthetic rubber sleeves, thus obviating the use of packing. Delivery is at the rate of 2 gal./min. and pressures up to 300 lb./sq. in. are obtainable by means of a relief valve. The pump is driven by a twin V-belt from a Villiers Mark 10, 1 h.p. 4-stroke air-cooled engine fitted with reduction gear. Overall dimensions are: length 20⅜ in., width 16¾ in., height 19 in. Weight is under 1 cwt.

At present, the 'Hydraulux Minor' is being supplied in a carrying chassis, at a price of £79. Other models on wheeled chassis, tank chassis and self-propelled are expected to be produced in the near future.

Salopian's 1953 Pick-Up Baler

A new pick-up baler was officially launched by Salopian Engineers Ltd. at the company's Spring Dealers' Conference held at Prees, Shropshire, recently. The new baler is available with any of three types of drive, *e.g.* P.T.O., Armstrong-Siddeley diesel engine, or both methods.

It is stated that the model has an output of high density bales exceeding 4 tons an hour; a larger model with bale output exceeding 6 tons an hour is also available. Features of the new model include reliable knotters, a new design of the pick-up reel so that individual tines can be replaced quickly, a swinging drawbar and reduced width.

Field Harvester

A new, big-capacity, dual-purpose McCormick International field harvester has been developed by the International Harvester Export Co. of Chicago. Known as the No. 20-C, it is said to harvest up to 25 tons of the heaviest forage or silage an hour. In one trip through the field it gathers the crop, chops it into desired lengths and delivers it to the truck or wagon. The basic unit consists of feeder, combination cutter-head and blower, blower discharge pipe, and power take-off drive or mounted engine. It features interchangeable row-crop and pick-up hay attachments which help the farmer to reduce his equipment investment.

The Swingfog unit seen at a recent demonstration in Germany using the insecticide Guesarol. This machine is reported to have been used successfully in malaria and yellow fever control

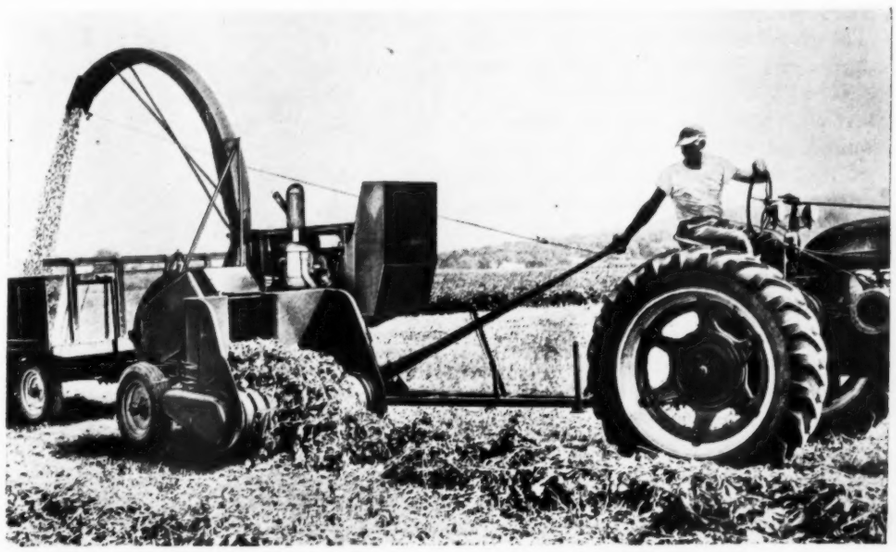
In most crop conditions, three-plough tractor power is said to be ample to operate the power take-off-driven field harvester. A 49 h.p. International engine can be mounted for a separate engine drive in unusually heavy yields, or when a smaller tractor is used.

The row-crop attachment will gather leaning or tangled stalks, gathering chains holding the stalks as they enter the gatherer and steadying them as they are cut by the sickle. Slatted steel feed aprons and a pair of rolls in the feeder carry the crop to the cutter-head through a 14-in. throat. The weight of the top feed apron and a spring on the top roll hold the crop firmly to the cutter-bar for clean cutting into uniform lengths. The hay pick-up attachment has a gentle raking action which provides high efficiency in both green and cured hay. It is 54 in. wide, to pick up the widest windrows.

Semi-Mounted Mower

There are already a considerable number of Massey-Harris 706 mowers in use and it is reported that with the approach of haymaking, farmers are taking delivery of this semi-mounted p.t.o. mower. The semi-mounted design of this type was selected by this company to achieve maximum flexibility with constant cutting power in all conditions. It is described as having a strong, well balanced frame, mounted on two free-moving castor wheels and is short coupled to the tractor for easy handling in the field.

The castor wheels—one on each side of the mower—are claimed to ensure even distribution of weight and to allow the 706 to follow every contour of the field, including variations from side to side as well as dips and rises in the land. Ball joint hitch forms a connection which provides horizontal and vertical freedom of



The new McCormick International No. 20-C field harvester, equipped with pickup attachment, lifts hay from the windrow and chops it to desired length

The Seligman-Horndraulic grab loading timber (*left*), **and loading silage** (*right*)

movement. The Massey-Harris cutter-bar has a constant knife speed. Two safety devices, a break-away release and a slip clutch, protect both mower and tractor. Should the cutter bar strike an obstruction, the release opens and allows the bar to swing back absorbing the full force of the shock. It is not necessary to leave the tractor to re-hitch, simply back up the tractor compressing the telescopic arm and the mower automatically re-couples. It is stated that the slip clutch at the end of the drive shaft prevents damage to the mechanism if small obstacles jam the cutter bar, and that the chain drive ensures trouble-free operation.

Demonstration of the Seligman-Horndraulic Grab

A demonstration of the Seligman-Horndraulic grab, mounted on a Fordson Major tractor, took place in Hampshire recently.

The grab was first demonstrated loading silage, 5 cwt. at a time, from a stack which had been sliced across to show how, when only small quantities of silage are required, the face of the silage can be kept neat and tidy. The second part of the demonstration showed the grab taking loads from the opposite end of the stack which had not been touched since the silage was first put into the stack. The grab tacked this job just as easily, but it did not leave quite such a tidy face and it is probable that, except where large daily quantities of silage are required, it would be more economical first to slice the silage.

The grab was next demonstrated loading heavy oak logs weighing between 7 and 10 cwt. each, and then moved to a clamp of farmyard manure which it dealt with easily.

Finally, the grab was demonstrated fitted with steel plates to the front and rear tines, loading coke, gravel and sand, corn sacks, and hay and straw bales. Very large loads of coke and gravel were collected and lifted.

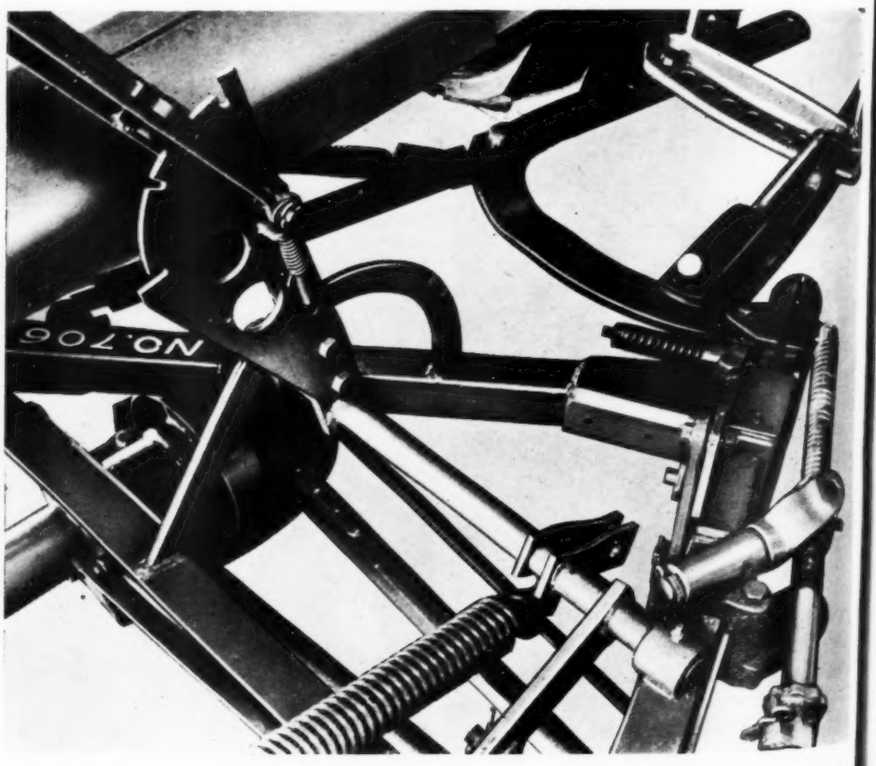
The grab itself, which can be fitted to most of the well-known makes of tractor, costs £78 10s.

It is pointed out that there are three conditions where the grab will not work successfully:

(1) The grab will not successfully load silage which has been made from very long old grass unless a hay-knife is used to slice across the silage.

(2) Where the entrance to a silage pit slopes very steeply down into the pit an ordinary wheel-tractor will not obtain sufficient wheel-grip under winter conditions to enable it to back up with its load to silage. Wheel strakes have been used successfully to overcome this difficulty.

(3) The grab will not deal successfully with very tightly compacted farmyard manure in a covered yard.



The semi-mounted design and new universal hitch of the Massey-Harris mower. A special jack provides a third wheel for moving the mower in the yard

WORLD CROP REPORTS

SOUTH AFRICA

Wheat crop. The 1952 wheat crop in the Union of South Africa was considerably smaller than the good wheat outputs of the past two years. The wheat harvest, normally completed in December, was estimated at about 19 million bushels, compared with about 25½ million bushels in 1951 and 26 million in 1950. Last year's crop was, however, still above the pre-war average of 16 million bushels.

The outlook for the maize crop harvested in April to May was for an output about the size of the poor crop harvested the previous year. The unfavourable outlook for maize is principally because of unfavourable weather in the Transvaal, where, after getting off to a good start, the crop was handicapped by excessive rains followed by a general drought. It is expected that imports of both wheat and maize will be needed to cover domestic requirements.

ARGENTINA

Grain harvest. The pre-harvest forecast of the Argentine Government for the harvest of small grains is said to confirm the private estimates of record or near-record outputs. According to the official figures, wheat production was the largest since 1940-41, barley and oats were near the all-time record and rye production was also large. The principal factors in the large outputs were high yields and below-average abandonment, but contrasting with the high yields for small grains, the outlook for maize is described as only average.

The small-grain harvest was delayed by heavy rains in late November, but from mid-December to mid-January warm, dry weather facilitated operations. The Government's forecast of about 270 million bushels of wheat contrasts with the virtual failure last year when the crop was estimated at 77 million bushels. It is still, however, considerably below the record output of 379 million bushels reported for 1938-39. The yields that year were less than the high level indicated for the current season, but the acreage was well above the present area. The specific weight and grade of the crop are reported to be much above the average, with virtually all the wheat of milling quality.

Some 125 million bushels of wheat are expected to be available for export, after deducting for domestic requirements and providing for the re-establishment of a normal reserve for carry-over.

TURKEY

Cotton crop. A record cotton crop was produced in Turkey during the 1952-53 season. The latest official estimate, 780,000 bales (500 lb. gross), was 91,000 bales above last season's relatively large crop. The 1952-53 cotton acreage, 1,660,000 acres, compares with 1,586,000 acres in 1951-52. This year's production may be primarily attributed to higher yields per acre, although increased acreage was partly responsible for the larger crop. Weather conditions in 1952-53 were generally favourable. No serious insect damage occurred as control measures, carried out jointly by the government and growers, were effective in minimising insect damage in the areas where infestation was reported. The principal precaution taken in 1952-53, to prevent the spread of pink bollworm, was the fumigation of the cottonseed to be used for planting in certain areas, particularly in the southern parts of the Aegean region where bollworm damage had been extensive in preceding years. Presumably the type of precautionary measures which were effective in combating insects in 1952-53 will again be used in 1953-54.

Consumption of raw cotton during 1951-52 amounted to 220,000 bales, about 23,000 bales of which were used by cottage industries for hand-spinning manufacture, mainly of mattresses and upholstery. Consumption in the preceding season (1950-51) totalled 210,000 bales.

U.S.A.

1953 wheat crop. The U.S. Department of Agriculture has stated that a generally mild winter and early spring, associated with improved soil moisture supplies from timely snows and rain, have materially improved the outlook for the wheat crop over a major portion of the country. The estimated 1953 winter wheat crop would be 32% below last year's second-largest crop of 1,053,000,000 bushels and 10% below the ten-year (1942-51) average of 797,200,000 bushels.

The Department believes that the spring crop will be in the neighbourhood of 310,000,000 bushels. If added to the estimated winter wheat harvest, a spring crop of this size would bring the total U.S. wheat crop in 1953 to about 1,024,000,000. This would compare with last year's third-largest crop of 1,291,000,000 bushels. This year's crop will be supplemented by a carry-over or reserve of about 556,000,000 bushels on July 1.

Cotton acreage reduction. The United States Secretary of Agriculture has asked American cotton farmers to voluntarily reduce their acreage to prevent low prices. He hopes that no more than 12 million bales of cotton will be produced this year as bumper crops in cotton in the last two years have provided ample supplies for sale and reserves.

Sugar beet production. About 801,000 acres are likely to be planted to beet in the United States this year. Last year, when the actual planted acreage reached 720,000 acres, two deficits in the Domestic Beet Quota were announced and, against an initial quota of 1,800,000 tons, raw value, only 1,559,524 tons were charged. With this year's increased acreage the possibility of another deficit becomes more remote.

(*From Czarnikow's ' Sugar.'*)

HUNGARY

Hungarian potato varieties. Among 16 new varieties of seed potato introduced in Hungary this year is one which is said to yield 170 to 200 cwt. an acre. Two new types of autumn yellow potatoes produced by the Kisvarda research station have a starch content 25% above that of the best Hungarian potatoes and are equally suitable for food and industrial purposes.

INDIA

Grain prospects. India is likely to import 2.5 million tons of food grains this year, as against the original estimate of 2.9 million tons. Giving this information in the House of the People, the Deputy Food Minister, Mr. M. V. Krishnappa, said that except in States like Madras, Mysore, Hyderabad, and the southern parts of Bombay, there has been marked improvement in food output. In the rice-growing areas of Madhya Pradesh, Orissa, and West Bengal, the crop was good and the wheat crop was normal. The grain crop in the north was also stated to be normal this year.

TUNISIA

Olive oil. The estimate for the 1952-53 edible oil production in Tunisia has now been revised to be between 36,000 and 38,000 tons, with an additional 3,800 tons of olive foots oil. The revision was made because of the continued lack of rains in the Sahel and Sfax regions of Tunisia that prevented the normal ripening of the olives. This figure is in striking contrast to the optimistic forecast of over 100,000 tons made in March 1952, and further reduces the estimate of around 50,000 tons

made late in January. Moreover, it means that output will be well below the 1943-52 average of 45,000 tons.

On the basis of a 38,000-ton yield, a carry-over stock of 5,500 tons from last season, and domestic needs totalling 33,000 tons, theoretically Tunisia could dispose of an 11,000-ton export surplus during the period November 1, 1952, to October 31, 1953. If, however, the authorities insist on a security margin and reserve a quantity for that purpose, the exportable surplus would be reduced by as much. It is reported, also, that domestic consumption during coming months should fall considerably short of the normal 2,750 tons monthly as a result of reduced purchasing power in the regions affected by the near-drought conditions.

AUSTRALIA

Wheat harvest. The Australian wheat harvest is now estimated at nearly 180 million bushels, according to the International Federation of Agricultural Producers. The estimate is about 17 million bushels higher than previous forecasts, and favourable weather is credited for the increased wheat production. Grain was sown over an estimated 10,100,000 acres in 1952-53, which is the smallest area for any peace-time year since 1923. The average yield from the 1952-53 production is expected to be 17.8 bushels an acre, which is equal to the previous record reached in 1949-50 and surpassing the pre-war average by 5.9 bushels.

WORLD

Rice production. World rice production in 1952-53—August to July—is estimated at a record of 357,000 million lb. of rough rice, compared with 337,000 million lb. a year earlier. The unusually large crop this year is attributed to record plantings and favourable weather in most countries. The previous record post-war harvest of 1948-49 was estimated at 342,000 million lb. of rough rice, which was about the same size as the largest world harvests before the war. In comparison, this season's world rice crop is estimated at 4% larger than the previous post-war record, at 6% above a year earlier, and at 7% more than the pre-war average output.

The two principal reasons for the outstanding increase in production have been the unusually high prices paid for rice in 1952 as a result of shortages in importing countries, which induced growers in all areas to increase plantings; and secondly, the concerted effort of world organisations and governments to stimulate rice production. The continent showing the largest gain is Asia, the 1952-53 production of which is estimated at 6% larger than in the preceding year and 3% above the pre-war average. Excluding China, Asia's production is estimated at 224,000 million lb. of rough rice, an increase of 12,000 million lb. over the preceding year, and 15 million lb., or 7% above the pre-war average output. Increases in production have occurred in most of the countries of Asia.

Pineapple production. The output of pineapple in the main producing countries amounted to 39.1 million boxes (70 lb. fresh equivalent) in 1952, compared with 39 million boxes in 1951 and the five-year (1935-39) average of 35 million boxes. In the important processing areas such as Malaya and Hawaii, the processed weight of segments was converted to the fresh equivalent on the basis of 1 lb. processed equals 1.709 lb. of fresh, and juice on the basis that 1 lb. is equivalent to 1.661 lb. of fresh fruit.

In the Western Hemisphere as a whole, production in 1952 showed little change from a year earlier, but in Mexico and Puerto Rico the crop was slightly lower. In the United States it increased substantially. In Hawaii, where about one-half of the world's pineapples are produced, the crop is indicated to be slightly larger than a year earlier. Most of the pineapples consumed in the United States, where production is relatively small, come from Mexico, Cuba, Hawaii and Puerto Rico. In Brazil the crop is largely consumed where grown and in 1952 was about the same as in 1951. Production in Malaya increased from 1 million to 1.2 million boxes, but in the Philippines decreased from 2.1 million to 1.9 million boxes. The South African crop also decreased slightly, but in Australia there was a slight increase.

Flaxseed production. World production of flaxseed in 1952 is now estimated at 134.6 million bushels. With output the highest since 1949, when it amounted to 141.2 million bushels, the estimate represents an increase of 9% from the output in 1951, but is only slightly greater than production in 1950.

Production in North America, comprising 34% of the world's output, totalled 45.9 million bushels. The reduction of roughly 1.0 million bushels from the previous season was due to declines in the United States and Mexico which were not fully offset by the sharp increase in Canada.

In Europe, where production in several countries was adversely affected by drought, the estimated production of 9.8 million bushels represents a decline of 4% from 1951. Increases are reported only for the Netherlands and Italy.

The Soviet Union is believed to have increased production from last year—to a level possibly approaching the pre-war average.

Production in Asia, exclusive of the U.S.S.R. and China, is estimated at 14.5 million bushels. This output, a decline of 12% from 1951, results chiefly from a drop of more than 2 million bushels in India's production.

In South America the estimated 30.3 million bushels produced—23% of the world's total—represents a sharp gain from the abnormally small production of 18.3 million bushels in the previous season. This pronounced increase is accounted for by Argentina's output which was more than twice the quantity harvested the year before. The relatively sharp decline in the estimate of Uruguay's production was due partly to lack of rain during the growing season and to extensive damage by heavy rains early in January when the crop was ready for harvest.

Flaxseed production in Africa, estimated at 2.5 million bushels, is up slightly from 1951. The decrease in production in French Morocco probably was more than offset by increases in Ethiopia and Egypt.

In Oceania, output of flaxseed in 1952 totalled 0.7 million bushels, a relatively substantial decline from 1951 owing to a sharp cutback in New Zealand's production.

Technical News

In the June issue of **Manufacturing Chemist** there is an article on ' Commercial Chromatography ' by O. F. Gee and H. Weil. Also included in this issue is an article by M. Schofield on ' Phosphoric Acid and Phosphates.'

' Roumanian Architecture Today ' is discussed by J. Cardew in **Building Digest,** and there is also a ' Review of Recent Developments in Office Lighting ' by C. F. Bassett in this number.

Muck Shifter for June includes an article by G. P. Robertson entitled ' Essential Factors in the Design of Bulldozers and Scrapers.' In addition, R. J. Salter writes on the ' Elements of Tidal Power.'

Graham Savile continues his series of articles on ' Transport and the Food Industry ' with Part V in the June issue of **Food Manufacture.** In this issue there is also a description of Sharp's toffee and boiled sweet factory at Maidstone.

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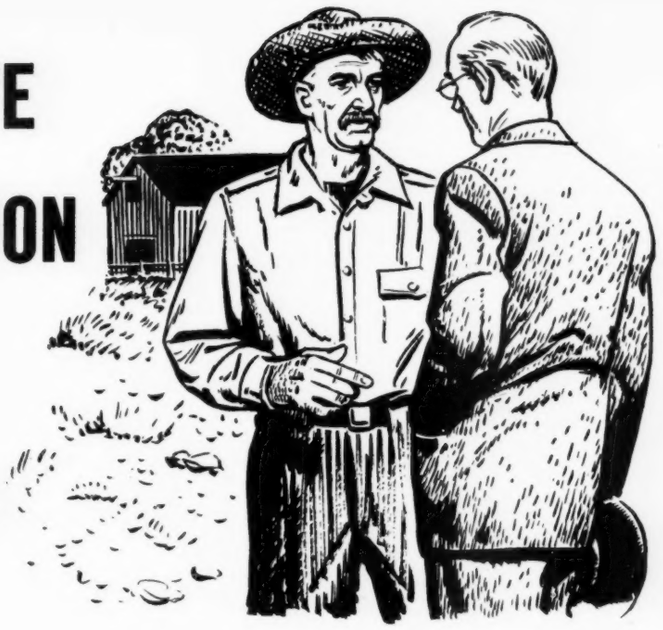

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Uruguay.....''Quimur'' Cia, Química Uruguaya, S.A., Montevideo.
Venezuela.....Andres Franceschi V., Caracas.

RUBBER GROWERS' ASSOCIATION

EFFECT OF AMERICAN RUBBER POLICY • PENAL BURDEN OF TAXATION • SIR SYDNEY PALMER'S REVIEW

The Ordinary General Meeting of The Rubber Growers' Association (Incorporated) was held on Friday, May 1, 1953. Sir Sydney Palmer, C.B.E., the chairman, who presided, in the course of his speech, said:—

Gentlemen,

I am sure you were all gratified to note in our Annual Report that our Company membership represents an area under rubber of $1\frac{3}{4}$ million acres, which is no less than 45% of the total estate acreage in all territories where our members operate. This is most encouraging and demonstrates the right of this Association to claim that it is the body most representative of estate rubber interests.

Improvement in Conditions in Malaya

One of the most welcome developments during the past year has been the improvement in conditions in Malaya. For this improvement our thanks are due to General Sir Gerald Templer, whose wise and energetic leadership has been an inspiration to everybody. We must not, however, forget the fine work done by the late Sir Henry Gurney and the late Sir Harold Briggs.

The reopening of the high-cost alcohol-based synthetic plants, the product of which is sold at far below cost, is in large measure responsible for the present disappointing offtake of natural rubber by U.S. manufacturers. The consequential decline in price is creating a very serious situation in South-East Asia. In the urge to ensure national security, the U.S.A. Government has unfortunately overlooked the inevitable repercussions elsewhere.

The Communist Menace

I would remind our American friends that national security is not only dependent on military preparedness, but also on having friendly allies with a sound economy throughout the world. The Communist menace is particularly strong in Asia. There are thousands of Communist agitators throughout South-East Asia pouring out a steady flow of propaganda against the Western Democracies, and the U.S.A. in particular. There is no doubt that every time the price of natural rubber falls, thereby lowering the Asian standard of living, the Communist agents tell the humblest worker in the most remote village that it is due to American manipulation.

If our American friends think I am painting an exaggerated picture, let them take note of what has already been happening. During the past few months the Government of Ceylon has made an agreement with the Government of Communist China to obtain rice in exchange for their rubber.

An Important Dollar Earner

Natural rubber is certainly the most important dollar earner for the sterling area. During the seven years since the end of the war, natural rubber exports to the U.S.A. have earned the sterling area $1,350 million. Taking into account exports to other dollar areas, it is estimated that in the post-war period rubber has earned the sterling area over $1,600 million. In 1951, when rubber prices reached their pre-war relationship with U.S. cotton prices, rubber is reckoned to have earned $400 million. In 1952 rubber's earnings dropped by half, and in 1953 it looks as if they may be less than $100 million.

When the U.S. Government ceases to spoon-feed industry with supplies of synthetic at call, a new situation will arise, and it will then be necessary for manufacturers and the trade to increase their working stocks of natural which are at a very low level. One day, and perhaps soon, it will be realised that natural rubber cannot for long be available at a price which for comparable grades is lower than the price of 23 cents at which GR-S is pegged by the American Government agencies.

As the present rubber situation has arisen as a result of American policy, I would have thought it reasonable to hope that a slight revision of this policy might create a situation wherein artificial correctives were not required.

As a starting point the governments of producing areas should surely endeavour to obtain conditions of free competition between natural and synthetic rubber on equal terms. For this purpose it will be necessary to ask the American Government first of all to dispense with all restrictive practices against natural rubber. The threat of the re-imposition of mandatory controls should be removed. In the second place the price at which the American Government is selling its synthetic rubber should be put on a commercial footing.

Taxation

Taking into consideration all the elements of taxation imposed on the industry, it is estimated that roughly 70% of our profits have been taken from us by governments. It is these profits upon which we are dependent for the improvement of our plantations so that from higher yielding material we may make ourselves more competitive with our synthetic rival. It is imperative, therefore, not only for the future prosperity of the natural rubber-producing industry but also for the economic betterment of the producing areas that there should be some amelioration of our taxation burden.

It is not only in regard to taxation, however, that governments in producing areas are hampering the industry. In Malaya, rubber companies are being called upon to meet the cost of regrouping, a measure imposed under the security regulations, which benefits the whole of the community. Now it has been announced by the Secretary of State for the Colonies that the Malayan Government has decided to appoint a Commission to enquire into the rubber industry. Despite this statement by the Colonial Secretary in the House of Commons on April 1, 1953, I understand that no decision has been taken by the Malayan Government on this question. I consider governments might well endeavour to help the industry and those dependent on it by less interference in domestic matters and by more positive action in the international sphere. The estate side of the industry has nothing to fear from such an enquiry and it is difficult to understand the necessity for it.

In Indonesia, our members are also faced with serious problems other than those relating to taxation, in which we hope the Indonesian Government will help. I refer to the uncertainty of the transfer of profits and the security of future land titles, and also the difficulties and delays encountered in obtaining entry permits for essential staff.

Promising Outlook

While the present and near future outlook for the industry is obscured by the policies adopted by the U.S. Government and the governments of the producing territories, the more distant outlook is promising. The consumption of rubber has been increasing steadily, and the development of new uses, together with increased consumption in established uses, suggests that by the end of this decade the total demand for rubber may be in excess of the existing productive capacity for both natural and synthetic rubber.

The report and accounts were adopted.

Mr. P. B. L. Coghlan was elected chairman, and Mr. K. M. G. Anderson was elected vice-chairman for the ensuing year.